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ABSTRACT

This paper explores the significance of experiential learning in promoting scholarship from a constructivist point of view. Chapter 1 examines the historical perspectives and educational theories that form the basis to experiential education. Chapter 2 explores the work of Jean Piaget, giving a description and explanation of his theories and how his theories relate to experiential education. Chapter 3 discusses the differences between Piagetian assessment methods and behavioralist assessment methods. In chapter 4, a description of the Master's Thesis project is provided along with a discussion on set up, materials involved, and methods and tasks used with 6 children ranging in age from 5 to 12 years old. Chapters 5 and 6 discuss how the use of the clinical method can improve understanding of children's construction of their own knowledge and how those findings can be used to help improve science curriculum. Chapter 7 highlights the need for experiential learning and constructivism to be taken into consideration in curriculum development in order to meet the developmental and intellectual needs of children. The final chapter discusses the importance of the community in learning, and the relationships of the people involved. Contains 88 references. (AA)

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A STUDY OF EXPERIENTIAL EDUCATION AND ITS RELATIONSHIP TO CONSTRUCTIVISM

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This paper is dedicated to my two children
Aaron Todd Prohaska and
Neill Samuel Prohaska
and to the children of Kino School

CONTENTS

ACKNOWLEDGMENTS i

INTRODUCTION 1

Chapter 1. THE HISTORICAL BASIS FOR EXPERIENTIAL EDUCATION 7

Chapter 2. THE PSYCHOLOGICAL BASIS FOR EXPERIENTIAL LEARNING 29

Chapter 3. MAKING USE OF PIAGETIAN RESEARCH AND ASSESSMENT TECHNIQUES 47

Chapter 4. EXPLANATION, DESCRIPTION, AND RATIONALIZATION OF RESEARCH 62

Chapter 5. INTERPRETATIONS AND FINDINGS 83

Chapter 6. DEVELOPING AN EXPERIENTIAL SCIENCE CURRICULUM 96

Chapter 7. EXPERIENTIAL EDUCATION AND CURRICULUM DEVELOPMENT 122

CONCLUSION 146

BIBLIOGRAPHY 149

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INTRODUCTION

My schooling as a child was in the public school system of California, where I experienced several different public schools. I graduated from high school, went to the local community college and then went on to Cal-State Long Beach in Long Beach, Ca. to get my elementary teaching certificate. While in the education program there, I worked as a teacher's aide in a public school kindergarten and then did my student teaching in first and fourth grade classes in a public school. I also substitute taught in public schools. All of this experience in the public school system, as a child and as an adult, led me to question the effectiveness of a traditional schooling system, from academic as well as emotional standpoints. I did not feel children were able to grow and learn to their full potential in a system that taught using rote methods and did not respect the needs of children. I also felt that traditional schooling was emotionally damaging to children in that it was an impersonal, arbitrary system which did not meet children's needs for relationships. This also would have the effect of getting in the way of academic learning. I was fortunate in that in my last semester in college, in 1969, I became involved in starting and teaching in a free school. I have taught in alternative schools since that time and have also been involved in the homeschooling movement. I have been a science teacher at Kino School in Tucson, Arizona for the last eight years. I work with children ranging in age from three to eighteen.

I feel that traditional education does not in any way work for children. I wanted to explore why this was so and what could be done about it. As a result of my prior teaching experience, the primary question I was dealing with when I started this project was, "Do children learn experientially and, if so, how?" The answer to the first question, for me, is an obvious yes. How can children not be learning experientially? I think many educators would agree that children learn in this way. Another question was: If the way children learn is experientially, why do traditional schools continue to use behaviorist, rote methods in their teaching? The next and most important question for me was: How do children learn experientially? Although I have known from my own experience with children and my own learning experiences that people learn experientially I did not know the way in which this happened. I wanted to, through a study of the literature, describe what has been found about experiential learning and, through the literature and my own research with children, get an idea of how experiential learning occurs. The way in which I went about discovering how children learn was through a study of Piaget and his learning theories and through the use of Piagetian research techniques.

In this paper I discuss my original research using Piagetian tasks with students and the role it played in answering the question: How do children learn experientially? What I found, through a study of the literature, was the concept of constructivism. Constructivism is the idea that children learn by constructing their own knowledge based on what they already know. The way in which they construct their own knowledge is through experience with objects, or as Piaget

stated, by "acting on objects." Piaget was the first to bring forth the theory of constructivist learning. His theory explains how children learn experientially and is the key to how children learn. The role my own research played was to help me understand how children reason and construct their own knowledge--that they must have many opportunities to act on objects in order to learn. Simply giving them information will not change already preconceived ideas they have about the world.

In the course of this research, further questions I found to be the most interesting and relevant to what I do were: What are children's ideas, theories, and explanations about scientific phenomena? and How can an understanding of these ideas help me become a better science teacher? These, along with the previously mentioned questions, are the ones I have explored in this paper.

In chapter 1 I have reviewed the literature on the early beginnings of what some educators and philosophers saw as the importance of allowing children direct experiences with the world in order to grow intellectually and emotionally. I examined the historical perspectives and educational theories that are relevant to experiential education. The theorists examined include Rousseau, Pestalozzi, Froebel, Mann and Dewey. I discussed each of these theorists as to how and in what way their theories are relevant to experiential education. I also discussed the Progressive Education movement of the early 1900's and the Alternative Schools movement of the 1960's and 70's. I felt it was important to explore the history of where experiential education came from in order to understand where it is now and where it is going.

Chapter 2 explores the work of Jean Piaget, giving a description and explanation of his theory and how this theory relates to experiential education. I examined why I feel his theories are almost exclusively the psychological basis for experiential learning. I discussed in detail the development of and basis for his clinical method, the development of and explanation of his stage theory, and definitions of terms that explain his theory. I also discussed what Piaget believed were the factors that drive structural changes from one stage to another and allow for cognitive growth. In this chapter I introduced Piaget's theory of constructivism, which is a central aspect of experiential learning.

Chapter 3 goes on to explore the differences between Piagetian assessment methods and behavioralist assessment methods. Since behavioralist assessment methods are those most commonly used, I wanted to compare the differences and discuss the reasons and advantages of using Piagetian methods as opposed to behavioralist methods. I discussed the fallacy of the belief that behaviorist methods are objective, whereas Piagetian techniques are not. I also discussed the reasoning behind the use of Piaget's clinical method in finding out not only what children's answers to questions are, but why they answer the way they do and what their reasoning is. I did this for the purpose of explaining the rationale for using his clinical method in my research project.

In chapter 4 I described my research and discussed why I chose to do this research. I discussed in detail a description of my project, how it was set up, the materials used, and the methods and tasks used with the children. In chapter 5 I discussed what I learned

about Piagetian stages, the use of the clinical method, children's reasoning, what I found about how children construct their own knowledge and how I can use these findings to help improve the science program at Kino and other schools.

I go on in chapter 6 to discuss science curriculum and how and why it needs to change in order to be consistent with constructivist learning. I discussed the problems with how science education is currently taught and what needs to be done to improve science education from an experiential perspective. I discussed the advantages and disadvantages of both traditional and experiential learning, how to deal with children's own theories about how the world works, the importance of choice by the child, of starting with the interests of the child, the importance of peer interaction, and what new paradigm we need for an experiential science curriculum to work.

In chapter 7 I discussed curriculum in general and how experiential learning and constructivism needs to be taken into consideration in curriculum development in order to meet the developmental and intellectual needs of children. I briefly described historical reforms in curriculum changes. I then discussed current criticisms of schools and curriculum and suggestions for solutions to these problems. This is all discussed in light of Piagetian theory and the construction of knowledge by children.

I end with a short conclusion on the importance of community in learning and the relationships of the people involved. I discussed my thoughts about why it is important to teach and learn experientially not only from an academic point of view, but from

emotional point of view as well--that learning experientially is not only better in terms of enhancing children's ability to obtain knowledge and think critically and creatively, but that it is better in terms of raising emotionally healthy, caring children.

CHAPTER 1

THE HISTORICAL BASIS FOR EXPERIENTIAL EDUCATION

In order to understand how children learn experientially I feel I need to explore the historical background of experiential education. The reason for this is I feel it is important to have an understanding of where experiential education came from in order to understand where it is now and where it is going. This background is needed to help me answer the question, "Why and how do children learn experientially?"

First, I will define what I think experiential education is. According to The American Heritage Dictionary, experiential means "pertaining to or derived from experience." Experiential education is education that involves learning by doing. The learner, whether a child or an adult, learns by becoming actively involved with the subject matter. For example, children at Kino School have direct experience, wherever possible, with what they are learning. One fourteen year old was interested in learning about Billy the Kid. This student read a fictional novel about Billy, read a biography of Billy's life and then compared the two in a written paper. As part of this project he also helped plan a field trip into New Mexico where he visited places Billy had lived and died. He visited Billy's grave site and discussed Billy's life with a docent at a museum. This study started with the student's interest. He was then helped to learn more about the subject in a very real way. Interest is a key to

learning through experience. For experience to be meaningful, it must start with the student's interest.

I took a beginning geology class my first year of college in 1965. It was a typical lecture/read the textbook class. In the text, we read about synclines and anticlines. As much as I read the text over and over to understand what these were, I just couldn't get it. We went on a field trip and I was able to see synclines and anticlines in the face of a cliff. I then understood right away. Experiential education is real learning--learners forget much of what they've read and memorized, but not what they've seen and done. I still know what synclines and anticlines are.

I first became involved in alternative education in the late 1960's. I read everything A.S. Neill, John Holt, George Dennison, Jonathan Kozol and Herbert Kohl wrote. They were the authorities and the basis for my philosophy of education. I had heard of John Dewey, Pestalozzi, Froebel and Rousseau, but had never really investigated their philosophies. Never having read their works, I assumed their philosophies were the same as the sixties educational philosophies. I was very surprised at how right I was in some ways and how wrong in others. I will briefly cover the time from Rousseau in the 1700's to Horace Mann in the 1800's. I will then go into more detail about John Dewey and the time from the Progressive Education movement in the late 1800's to the Alternative Schools movement, which ended at the end of the 1970's.

Jean Jacques Rousseau lived from 1712 to 1778. He was a Swiss-born French philosopher who was opposed to all forms of repression. In writing Emile in 1762, Rousseau was one of the

earliest philosophers to advocate the importance of experiential education. Rousseau states, "Life is the business I would have him learn . . . Whatever the changes of fortune he will always be able to find a place for himself" (Boyd 1956, 15). Learning about life directly, rather than just facts out of a book, is the basis for experiential education. It involves learning how to learn, which will last a lifetime, rather than just learning facts, many of which will be forgotten. Rousseau believed in the natural goodness of children and because of this belief, trusted them to learn through what interested them--it was for the child to lead the way in what s/he learned. He believed children should be allowed to interact closely with nature and have many concrete experiences from which to learn.

Rousseau changed the way children were viewed. Before Rousseau it was thought that all individuals had equal intelligence and that education was the only limiting factor. After Rousseau, the individual differences of students began to be taken into account (Dewey 1916, 117). In many ways, Rousseau was way ahead of his time and was persecuted for being so. The government of France ordered his arrest after he wrote Emile. He moved to Motiers, Switzerland and was then forced to move from there by the townspeople. Advocating for the humanistic upbringing of children seems to bring out violence in some people. Rousseau eventually moved to France where he died.

Johann Heinrich Pestalozzi was born in Switzerland and lived from 1746 to 1827. Although he never met or exchanged ideas with Rousseau, he became a disciple of his after reading Emile at the age of 18. He then began to spread Rousseau's ideas. Pestalozzi's ideas

about children are directly related to Rousseau's. He believed children learned best through the natural world. He felt instruction through the "sense impressions" of "Nature" to be the only true way to learn (Pestalozzi 1898, 315). He thought learning for children should go from the concrete to the abstract--"I wish to make words and talk unimportant on the human mind, and to secure that preponderance due to the actual impressions of physical objects, that forms such a remarkable protection against mere noise and empty sound" (Pestalozzi 1898, 322). As well as believing children should learn experientially, Pestalozzi also believed that learning should come from their interests--"Self-knowledge, then, is the centre from which all human instruction must start" (Pestalozzi 1898, 334). This goes hand in hand with experiential learning. He also felt a good education was necessary in order for people to govern themselves.

Friedrich Froebel, born in Germany, lived from 1782 to 1852. Froebel is known for starting the first kindergartens or "children's gardens". He was a teacher under Herr Gruner who was a pupil of Pestalozzi's. Froebel also studied under Pestalozzi at Yverdun, Switzerland in 1808 (Lawrence 1969, 18). He felt children should be allowed to develop according to their nature, which he thought was innately good. Froebel started the first kindergarten in Keilhau in 1837. He thought that a child's learning was continuous and cumulative and he felt early learning had been neglected. For this reason, he felt it was vital that the beginnings of the child's education be right. In his school, children were to be allowed to develop freely. Activities, which were called "gifts," were to provide for play, dexterity of movement, and teach about the laws of nature

(Lawrence 1969, 22). Music and action games were an important part of the curriculum. The school was child-centered, which meant it focused on the interests of the children. As well as starting kindergartens, Froebel also started teacher training schools for kindergarten teachers. His influence is strongly evident in the kindergartens of today. Froebel, like Rousseau and Pestalozzi, believed in the innate goodness and children and that children learn best through their experiences.

Horace Mann lived from 1796 to 1859. He was one of the main influences for the development of a free public school system in the United States. Mann's contribution to progressive education focused more on changing society than previous reformers. Mann's main goal was to further democracy by educating people who could think for themselves. He also believed in the innate goodness of people. Mann believed public education would be the salvation of society--that education in a democracy would end all war, poverty, class differences and prejudice. He thought public education would give a common value system to the American people. I feel this is possible only if the American people work together to allow it to happen. War, poverty, class distinctions and prejudice, to name a few, have gotten in the way of allowing the public school system to be the best that it could be. Mann did believe that children were individuals and their differences needed to be taken into account when educating them. He was influenced by both Rousseau and Pestalozzi (Cremin 1964, 11).

The Progressive Education movement in the United States lasted from 1876 to 1957. The movement started in response to

deplorable conditions in the public schools at the time. It began simply as a humanitarian effort to improve the lives of individuals (Cremin 1964, viii). From there it grew into a new philosophy of education for American schools. In 1919 the movement was formalized with the founding of the Progressive Education Association by Stanwood Cobb and others in Washington, D.C. who were interested in educational reform. "Our aim from the very beginning had in it little of modesty," Cobb reminisced in 1929. "We aimed at nothing short of reforming the entire school system of America" (Cremin 1964, 241). Progressive educators felt the following ideas to be important to education:

1. Individual differences among children must be recognized.
2. We learn best by doing and by having a vital interest in what we are doing.
3. Education is a continuous reconstruction of living experiences that goes beyond the four walls of the classroom.
4. The classroom should be a laboratory for democracy.
5. Social goals, as well as intellectual goals, are important.
6. A child must be taught to think critically rather than to accept blindly (Nathan 1976, 4).

John Dewey is thought to be one of the main intellectual influences of the Progressive Education movement. He lived from 1859 to 1952. He received his Doctor of Philosophy degree from Johns Hopkins University in Baltimore, Maryland in 1884. He and his wife, Alice, were the founders and directors of the Experimental School at the University of Chicago from 1896 to 1904. Although closely associated with the Progressive Education movement, Dewey became critical of progressive education as early as 1926. He was critical of progressive schools that rejected the orderly organization of subject mattter and were, what he considered to be, child-

centered. For the most part, Dewey distanced himself from this movement starting in the mid-1920's (Archambault 1966,17).

Dewey was influenced early on by William James' Principles of Psychology. James believed that the mind is influenced by the environment and that it also reacts upon the environment in an actively creative way. He also believed, as Dewey did, in using education to effect social change. One of Dewey's motivations for furthering progressive education seemed to be his desire for social change. The social aim Dewey sought to further through education was a well-informed population who could make informed decisions. Dewey felt all subject matter must be taught only if they prove themselves useful instruments of social diagnosis and social progress. He felt history should be taught only in relation to helping solve present day problems--that interest in the past for its own sake was not legitimate (Archambault 1966, 57). Progressive education for Dewey was a means to a social end rather then being legitimate in and of itself. I also feel that Dewey discussed finding a new way of organizing subject matter partially to justify progressive education to more conservative educators.

In the late 1890's, because of the Industrial Revolution, education that had taken place in the family, neighborhood or shop was no longer happening. There was a call from many different factions for educational reform. Dewey laid the blame for educational problems on the Industrial Revolution. He felt there was a need to return to the educational aspects of traditional agrarian life within the schools. He wanted each school to function as a community. I agree with Dewey's idea of the school being a

community, but I have come to this belief for different reasons. I believe that Dewey's foremost goal in advocating his new education was not what was in the best interest of the individual child, but what was in the best interest of the group. He had good intentions for society. He wanted social reform through education. He stated, "The things which are socially most fundamental, that is, which have to do with experience in which the widest groups share, are the essentials. The things which represent the needs of specialized groups and technical pursuits are secondary" (Dewey 1916, 225). I believe it is of utmost importance to foster a sense of community in a school, for the individual within the group. The ultimate end is that the group also benefits. The sense of community or family gives the child a feeling of trust and caring--it gives the child good self-esteem and empowers the child. An individual with a feeling of trust, caring and good self-esteem will be a good, caring member of the community. The goal is to help the child feel important as an individual, but not to the detriment of others. I believe the most good can be done for society by allowing children to make their own decisions about what they learn and how they learn.

Dewey had many criticisms of the traditional school system, most with which I agree. He felt that the child's life is an integral, total one and that in school it is divided and compartmentalized. He felt there was a problem with the unity of the child's life and the divisions in curriculum. This can still be seen in traditional schools where the day is divided up into hours with certain subjects being taught during each time period. He saw that traditional educators ignored the child's individual experiences. Dewey felt that individual

experiences and subject matter should be brought together. Again, in traditional schools, there is a predetermined curriculum for each grade level with no thought for individual abilities or interests. He stated three "evils" in the external presentation of subject matter. One was using symbols to represent something the child had no experience with. Another was lack of motivation. In order to be motivated there must be some interest coming from within the child. The last was that the quality of the subject matter is lost when presented as just facts to be memorized (Dewey 1900, 38).

One of the main themes running through all of Dewey's books is the importance of experience and education. By experience he meant learning through experiences. He discussed the principle of continuity of experience. By this he meant "that every experience both takes up something from those which have gone before and modifies in some way the quality of those which come after" (Dewey 1938, 35). This is the essence of experiential education--that each experience builds on the ones that a child has already had and influences the experiences that the child will have. Unfortunately, Dewey felt that some experiences were not worthwhile educationally. I do not believe this is so. There may be life experiences that are very negative, but I believe a person learns from everything s/he does. I also don't think obvious negative experiences were what Dewey was referring to. I think he put value judgements on those activities he considered educationally valuable and those he didn't. The activities he did not consider educationally valuable he labeled "miseducative". What he would label "miseducative" would be merely a value judgement on his part. Dewey determined what was

and what was not worthwhile in terms of whether or not he, as the adult, felt the activity was valuable. He did not give specific examples of what activities he felt were "miseducative". I believe that any activity a child is engaged with, focused on, and passionate about, is the best learning activity for that child.

At Kino, children work on projects they are interested in, usually in groups, and sometimes individually. We do not place value judgements on a child's interests--we do not decide that what they are interested in is not worthwhile and try to guide them in another direction. Instead, we encourage and facilitate their learning about their interests. In this way, they not only learn academically, but they also learn that they are important, what they are interested in is important, and they learn how to learn. We are more interested in the process of education, than in the content or product. We began using the project approach to learning at Kino School two years ago. In these last two years, I have seen students become much more involved and much more excited about learning.

Dewey's idea of freedom is somewhat different from mine. He believed that the only important freedom was that of intellectual activity used for purposes that were "intrinsically worthwhile" (Dewey 1938, 61). Again, Dewey is not specific about what he considers to be intrinsically worthwhile. The sense I got from reading his books is that he does not consider an activity to be worthwhile if it does not in some way have a social purpose. He states that freedom cannot be treated as an end in itself because, "It then tends to be destructive of the shared cooperative activities which are the normal source of order" (Dewey 1938, 63). The

question is, "Who decides what activities are worthwhile?" I believe that the ability to decide for yourself what intellectual activities are most worthwhile for yourself is true freedom and is truly empowering. The only person who can really know what is best for me is myself.

Dewey was in some ways very frustrating to read. There was much that he said with which I agreed. I was surprised to hear these views coming from the past, so to speak. He then would make a statement with which I didn't agree at all. These statements make me feel that in some very fundamental ways our philosophies are different. I absolutely believe and trust in the innate abilities of children to grow, learn, and direct their own lives. I believe that Dewey does, but not quite. I assumed the basis for the Progressive Education movement and Dewey's ideas were the same as the Alternative Schools movement of the 1960's--they weren't. I feel the Alternative Schools movement was based on several ideas: that children are naturally good; that children want to learn; that they are capable of making decisions; and that they learn best through experience. I think Dewey believed these same ideas, up to a point. I think he believed children could make some decisions about their education, but not others. A child was allowed to make decisions as long as the teacher felt the decision was a good one. A child was allowed to decide what activities s/he wanted to do as long as the activities were learning activities, <u>as defined by the teacher.</u> In the Alternative Schools movement, it was assumed that if a child was positively and constructively involved in an activity then s/he was learning. One statement Dewey makes which clearly points out our

differences in philosophy is, "The educator who receives the child at the end of the period (infancy/preschool) has to find ways for doing consciously and deliberately what 'nature' accomplishes in the earlier years" (Dewey 1938, 74). I believe, even after the preschool years, in allowing the "nature" of children to guide their education.

In one of his later books, Experience and Education, Dewey discussed the importance of looking at educational philosophy in a positive rather than negative way. He wanted the progressive education movement to look at the problems in education, and then rather than taking sides for or against, to develop a positive plan of action. He stated, "A philosophy which proceeds on the basis of rejection, of sheer opposition, will neglect important questions" (Dewey 1938, 21). This is a very important point, as it seems that in both the Progressive Education movement and later in the Alternative Schools movement, there was much discussion of rejection of ideas by some groups, when there could have been more positive plans for children, although this certainly was going on also. I was witness to both in the 1960's movement.

I do not mean to be overly critical of John Dewey. I think he had a great influence on changing schools and the way that people look at learning and children. I was involved in the Free School movement of the 1960's. I believe that in order for children to learn they must truly be trusted by the adults that are helping them. If, as an adult, you have your own idea of what children ought to learn, then I believe you are going to get in the way of their learning.

Although Dewey is the educator most often thought of in connection with the Progressive Education movement, there were

many other progressive educators who were much more involved in the movement than he. Dewey referred to Francis W. Parker as the "father of progressive education" (Cremin 1964, 129). Parker had traveled widely in Europe to study educational innovators. He was influenced by both Pestalozzi and Froebel. Parker returned to the United States and was hired as the Quincy, Massachusetts superintendent of schools in 1875. There he made major changes in the school system. He threw out textbooks and used trade books and other materials to teach reading; math was taught using objects; geography was taught with field trips; drawing was introduced; the emphasis was on observing, describing and understanding (Cremin 1964, 129). This sounds very much like Kino and must have been looked on with horror by some people and delight by others. Parker received national attention, which he was not so sure he wanted:

> I repeat that I am simply trying to apply well established principles of teaching, principles derived directly from the laws of the mind. The methods springing from them are found in the development of every child. They are used everywhere except in school. I have introduced no new principle, method, or detail. No experiments have been tried, and there is no peculiar 'Quincy System' (Cremin 1964, 130).

I agree wholeheartedly with Parker. The methods used in progressive and alternative schools are just common sense. There were of course many critics of this common sense. There were complaints from Quincy residents that the basics were being ignored and education was being subverted (Cremin 1964, 130). These are the same complaints that are given today when progressive ideas are tried in traditional schools. In spite of these criticisms, this program continued to flourish. Parker was with the Quincy schools from 1875

to 1880. He then took his ideas to the practice school of the Cook County Normal School in Chicago, where Dewey's own children attended school until the Deweys started their own school at the University of Chicago.

Another educator deeply involved in the Progressive Education movement was William Heard Kilpatrick. Kilpatrick joined the faculty of Teachers College at Columbia University in 1913. There he taught Dewey's ideas to a generation of teachers (Cremin 1964, 173). Kilpatrick is best known for the development of what is known as "The Project Method." He wrote and published an essay on his method which caused him to become nationally and internationally famous. In this essay he presented "wholehearted purposeful activity proceeding in a social environment" as a new pedagogical principle (Cremin 1964, 216). Kilpatrick consistently supported the child over the subject matter and was child-centered. His difference here with Dewey is obvious. Although Dewey definitely supported problem-solving and the interests of children, he was more concerned with developing a new curriculum and subject matter to take the place of the old (Cremin 1964, 219).

One of the few studies of students coming out of progressive schools was the Eight-Year Study, started in 1932 and ending in 1940. This study came directly from the wish of educational reformers to give students ". . . an understanding and appreciation for the way of life we call democracy" (Jervis and Montag 1991, 54). There was a strong interest in using curricular innovation as a way of meeting this goal. This was hampered though by strict college entrance requirements. The Progressive Education Association

appointed Wilford Aikin to head the Commission on the Relation of School and College. He looked for ways in which schools could experiment with fundamental curricular changes without sacrificing their students educational future. Three hundred colleges and universities agreed to waive their entrance requirements for five years for the graduates of these schools (Aiken 1985, 29; Mitchell 1985, 13; Whitford and Vance 1979, 350). This allowed the thirty schools involved in this study to be as innovative in their curriculum development as they wished. The development of innovative curriculum in these high schools was the first part of this study.

In the follow-up to this study, 1475 students from thirty progressive schools were matched with graduates of traditional schools. Each graduate from the thirty schools was carefully matched with a graduate from a traditional school based on scholastic aptitude score, race, age, sex, religion, socio-economic status, vocational objectives, participation in extra-curricular activities, size, type, and geographical location of the home community, size and type of secondary school, and public or private education. The data collected in this study represented 189,000 credits earned over 6400 student years (Mitchell 1985, 17). This was an extremely thorough study.

The follow-up study began in 1936 as the first high school graduates entered college. A new graduating class was added each year until 1939. The conclusions of this study were that progressive school graduates earned higher grade point averages, received slightly more academic honors, were found to be more objective, precise and curious, were more resourceful and had more concern for world affairs. One point I found interesting was that the graduates

of the most progressive schools were much more successful than their matches, while there was not as much difference between the graduates of less progressive schools and their matches (Aiken 1985, 29; Mitchell 1985, 18; Sclan 1990, 50-51).

As the Eight-Year Study ended in 1940, regional meetings were held across the country at Columbia, Pennsylvania, Chicago, Harvard, Denver, and UCLA. This study had been the ". . . broadest, most carefully planned, and well-executed examination of curriculum ever made" (Mitchell 1985, 19). No one questioned its findings at that time or since. There were plans for extensive publicity, then Pearl Harbor was attacked. All publicity after that had to do with the war. After the war, the Progressive Education Association and other organizations were labeled, along with their leaders, as communist (Mitchell 1985, 19). Since that time, this study has all but been forgotten. Max McConn, the Dean of Lehigh University at the time, felt that this study proved that a traditional curriculum was not necessary for success in college. He stated:

> From now on if any individual dogmatically asserts that the traditional program is essential for college success, he can be politely assured that he is talking nonsense, which has been proved to be nonsense, and can be counseled to consult the evidence before conversing further on this topic (Mitchell 1985, 20; Whitford and Vance 1979, 352).

Kathy Irwin feels, and I agree, that we need the ideas from the Eight-Year Study today; that this study speaks to the present and we only need to listen in order to develop schools that will nurture democratic citizens (Jervis and Montag 1991, 59).

Lawrence Cremin gives several reasons for the failure of the Progressive Education movement. One was distortion of the

movement by the press. The strife between minority factions of the movement made headlines and gave material for progressive education political cartoons. Second, was that the participants of the movement seemed to know more about what they were against than what they were for. Third, was the reality of what it took to be a teacher in a progressive program--lots of time, commitment and knowledge. Too many teachers were not willing to give what was needed and were not trained to do so. Fourth, the movement had trouble moving forward once it had achieved some success. Once some changes were made in schools, progressives found themselves locked into those programs and unable to make further changes. Fifth, was the effect of the swing toward conservatism after World War II. Sixth, was the lack of nonprofessional support which any educational movement needs in order to survive. Last, was that progressive education did not keep up with the transformation of American society. The United States was changing rapidly and was not the same nation as the one that progressive education started in. Some of these changes included: the conclusion of the great immigrations with the country trying to redefine community; earlier ideas of vocational education being outmoded by the use of new energy sources and the expansion of automatic controls in industry; and new information being generated at a rapid pace along with the problem of how to transmit it (Cremin 1964, 348).

In reading about both Dewey and the Progressive Education movement, I find them to be much more conservative than the Alternative Schools movement which existed in the 1960's and 70's. There is a common thread in most of the writings of the progressives

of a subtle kind of guidance, of controlling children for their own good and of obedience being an end goal. The stated goals of the Progressive Education movement were also some of the goals of the Alternative Schools movement, but with a difference. The Alternative Schools movement was much more willing to do away with academic requirements and even advocated abolishing schools. I feel the people involved in the Alternative Schools movement had more trust in children.

The Alternative Schools movement was helped along by the social changes that were being brought about in the 1960's with the Civil Rights movement and the anti-war movement. In addition to these changes was the interest in a search for personal growth (Lindenfield 1974, 14). The publishing in 1960 of Summerhill: A Radical Approach to Child Rearing by A.S. Neill was also a big influence in giving direction to this movement. Neill's views of non-coercion and freedom fit in with the anti-authority sentiment of the 1960's (Nathan 1976, 6). As of 1976, there were four main types of alternative schools: street academies set up by minorities, usually in inner cities; free schools; the older Progressive schools; and public alternative schools (Nathan 1976, 9). The Free School movement was an offshoot of the Alternative Schools movement. Free Schools were of two types. The first were the Freedom Schools which grew out of the Southern civil rights movement. There were also the community schools street academies of the inner cities in both the North and the South. These schools were started as a protest and boycott of the public school systems that blacks felt were oppressive (Fantini 1973,

14). Alternative education was seen as a way to liberate children, as well as a way to radical social change (Cremin 1974, 72).

The second type of Free Schools were schools in which the adults were much more facilitators than teachers; where there were no letter grades, and children were not separated by age; where there was no set curriculum and no academic requirements; and, most importantly, where there was self-government. Free Schools and Alternative Schools, like Progressive Schools before them, were started primarily by dissatisfied parents and teachers. Parents wanted to pass on their values to their children and felt this could not be done in the public school system. This is certainly one of the many reasons I was always determined, as a parent, that my children would never have to attend public school.

The New Schools Exchange Newsletter, which was in existence from 1969 to 1978, claimed to be "the only central resource and clearing house for all people involved in alternatives in education." This group put out an excellent newsletter and also sponsored conferences. The newsletter consisted of articles by teachers and students working in alternative schools and by well known educators, events of interest to alternative school teachers and students, bibliographies, people looking for jobs, places looking for teachers and students, and a yearly directory of alternative/free schools. Anyone wanting to find out anything about alternative schools could go to this source for help. The National Coalition of Alternative Community Schools was started in 1976 and is still in existence. I served on the board of directors of this organization for three years and was the newsletter editor for one year. The Coalition

newsletter is similar to the New Schools Exchange Newsletter. Many of the people involved in this organization are homeschoolers. John Holt's Growing Without Schooling newsletter is a major publication for homeschoolers. As a movement, homeschoolers seemed to be in the greatest numbers and the most organized at this point in time. Although there are still alternative schools, such as Kino School, there does not seem to be a well organized movement today.

Although both the Progressive Education movement and the Alternative Schools movement were given press that indicated widespread changes, there were really very few changes, especially in the public school system. There were very few public schools that made any changes at all, and the few that were made were for the most part simply surface changes. The basic structure of learning in the classroom had not changed--schools were built with more physically open settings, but were still used as contained classrooms; children were allowed to sit in carpeted areas or on couches to do their written work instead of at desks. There were very few public schools that made substantial changes and most of those have either closed or reverted to traditional schools.

Lawrence Cremin states several problems of the Free School movement. One is the "notoriously atheoretical, ahistorical character" of the Free School movement (Cremin 1974, 72). The people involved in this movement were, for the most part, not interested in looking to history for answers. They did not trust the past or "authorities" on the subject of education or anything else for that matter. They were not progressive educators, they were free school educators. This was helpful in some ways and not so helpful in

others. It was helpful in that teachers were freed to be creative in their work with children. Also, although they didn't look to the past for help, they did look to the present in writers such as Neill, Dennison, Holt, Kohl and Kozol. This attitude was not helpful in that the movement didn't have as much credibility as it could have had. Cremin felt the movement failed at the point of theory. He felt it did not ask the right questions insistently enough and as a result came up with superficial answers. I think what Cremin meant by this was that the questions asked were answered, but answered without linking theory with practice. Free school educators did what worked or seemed to work for them in their individual schools, but they did not look at the overall picture in order to develop a theory of what worked and why. I feel the people involved in this movement were simply cynical and fed up with academicians.

Another problem was the movement's difficulty in going from protest to reform (Cremin 1974, 73). While there was much criticism of the traditional school system, there was not much in the way of definite solutions. I agree with this to some degree. I feel that there was not much in the way of organized solutions, but that is partly the nature of the people involved in this movement. They didn't believe in a formula for success or the "right" way to run a school. They believed in allowing people to find their own solutions that worked best for them.

Cremin felt the last problem was that the Free School movement was as "school-bound" as the Progressive Education movement (Cremin 1974, 73). Although there was some discussion of de-schooling society, on the whole, the movement didn't really

think in terms of doing away with schools altogether. At the present time, only the homeschooling movement has taken this on as a solution to the schooling problems. Although there doesn't seem to be a movement, as such, at the present time, isolated schools and individuals continue to give choices and opportunities to what students they can. All of the educators and philosophers involved in the promotion of experiential education have several things in common. They believe that children are innately good and trust children to learn without coercion. They believe in allowing the child to learn by following her/his own interests; in learning from experiences; that concrete experiences are especially important; in the importance of play; in learning from the natural world; in self-government and community; in teaching children to think for themselves; and, that allowing children to learn in these ways, will make for a better world.

Researching this chapter has been extremely helpful to me in making me stop, so to speak, and look at what I am and have been doing in education since 1969 when I started teaching in alternative schools. I now appreciate the continuity of the humanistic ideas that have come down from the 1700's. Exploring the history of experiential education has given me a perspective on what has been going on and what is going on in experiential education that I would not otherwise have had.

CHAPTER 2

THE PSYCHOLOGICAL FOUNDATIONS OF EXPERIENTIAL LEARNING

The ideas I explored in this chapter focus on my basic question of how children learn experientially. What I found was the psychological foundations for experiential learning are based almost exclusively on the studies of Jean Piaget. His studies are the base that other psychologists and educators use, who advocate experiential learning. The work of Piaget is so immense that it is difficult to cover in one chapter. In this chapter, I will attempt to outline the basic theory and terminologies of Piaget and interpretations of his theory by other psychologists. I will describe the way in which Piaget's theories show how children learn experientially. I will also introduce constructivist theory in this chapter.

Piaget was born in Neuchatel, Switzerland in 1896. He was a very precocious child. He became interested in science at an early age, especially the biological sciences. Before the age of twenty-one, he had published about twenty papers on mollusks and other zoological matters. He received his doctorate in natural sciences in 1918, at the age of twenty-two, from the University of Neuchatel. Throughout his time at the university, Piaget did extensive reading which brought him to several beliefs. One was that biology, the study of the science of life, could be related to epistemology, the study of the science of knowledge. Another was that external

actions, as well as the thought processes, come out of a logical cognitive organization. A third was his view on the totality or wholeness of cognitive structures and the equilibrium that characterize those structures (Flavell 1963, 2).

Jean Jacques Rousseau, previously discussed in chapter 1, influenced the thinking of Piaget. Rousseau believed in the perfection of nature and the perversion of society. Because of this, Piaget felt Rousseau had the first total conception that childhood, in that it is natural, has a function. Rousseau felt it would benefit society to make use of the child's natural mental development, instead of getting in its way. Rousseau, as a philosopher, knew instinctively what Piaget, as a psychologist, had found scientifically. One question Piaget asked was, "Is childhood a necessary evil, or have the characteristics of the childish mentality a functional significance that defines a genuine activity?" (Piaget 1977, 138). Piaget believed that the process of childhood was necessary for the normal and complete intellectual growth of the individual. I agree with this. Rather than trying to force children into an adult learning mold, we need to allow them to learn in the way that is most biologically suitable for them. Piaget showed that children need to start from the concrete and work to the abstract--that children, in fact, cannot learn abstract concepts if they do not have a solid concrete base. This includes allowing children to do activities based on their experiences and interests. "When the active school requires that the student's effort should come from the student himself instead of being imposed, and that his intelligence should undertake authentic work instead of accepting pre-digested knowledge from

outside, it is therefore simply asking that the laws of all intelligence should be respected" (Piaget 1977, 159). Piaget felt that Pestalozzi, a student of Rousseau's, and Froebel, a student of Pestalozzi's, developed the beginnings of activity-based learning methods, because they used Rousseau's ideas in the field of schooling. Piaget did feel that these educational theorists failed to establish the psychological background necessary to develop educational techniques adapted to the laws of mental development. Piaget states, "What Rousseauism lacked in order to succeed in constituting a science of education was a psychology of mental development" (Piaget 1977, 141).

About two years after receiving his doctorate, Piaget worked in Alfred Binet's laboratory in a Paris grade school. He was given the job of standardizing reasoning tests done on Parisian children. Here he became interested in the processes children used to get their answers--especially their incorrect answers. It was here that he developed his "clinical method," which became a trademark of Piaget's. He developed techniques for questioning children so that he could find out why they answered questions as they did. Based on a publication as a result of his work, Piaget was offered the job of Director of Studies at the Institut J. J. Rousseau in Geneva in 1921 (Flavell 1963, 3). It was here he expanded on his clinical method and developed his "method of critical exploration" using object oriented tasks, rather than just questioning methods. He gave children tasks using concrete manipulative materials, followed by questions which forced the child to justify her/his response (Pulaski 1980, 5). I discuss the use I made of this method in chapters 4 and 5

of this paper. I used this method using traditional Piagetian tasks with six students. I also integrated what I learned about children's reasoning and their construction of their own knowledge into my work with my science groups.

Piaget was an interactionist and a constructionist. He believed individuals learn by seeking out knowledge, organizing it, and assimilating it into their previous state of knowledge. He believed children construct their own knowledge based on what they already know. Piaget studied the reasoning of children. He wanted to learn what paths they used to reach their answers. Piaget was the rare psychologist who tried to understand not only what a young child was saying, but <u>why</u> s/he was saying it (Pulaski 1980, 2). I feel this is one of the most important aspects of his work. He really tried to see things from the child's point of view and as a result discovered many important aspects of a child's learning. Some of these were that children need concrete experiences in order eventually to function abstractly; that in order for children to learn most effectively, experience and the interest go hand in hand; that children were not always answering the question the adult was asking, and that therefore their thinking was different than an adult's.

I feel Piaget's idea that the child structures or constructs her/his own knowledge is a central feature of his work. He saw the actions of the child as the primary source of knowledge rather than the traditional sources of perception and language (Beilin 1992, 195). Prior to Piaget it was thought that children learned merely from their perceptions. It was also believed that thought was structured

by language. Piaget's studies found that language is structured by thought. What this means is that what structures thought is not language, but the child's action upon objects and the logical operations that are built from those actions. Children can be taught the language that goes with logical operations, but they cannot assimilate what the language means until they construct the operations for themselves. Piaget believed that the main purpose of language is to communicate what is already known (Pulaski 1980, 95).

Piaget discussed adaptation and organization as being the two basic characteristics of learning and that they are functional invariants. By this he meant that their functions remain the same across all stages of growth. Adaptation simply means the process of the organism adapting to the environment in order to get what it needs to survive, whether biologically or intellectually. The two aspects of adaptation are assimilation and accommodation. Assimilation is the process of taking in information from the environment and integrating that information into the organism's existing cognitive structure, and in the process creating new structures. Assimilation changes incoming information so that it fits into already existing knowledge. Assimilation allows for growth, but not change. For example, if a child knows what a dog is, when s/he sees a new breed of dog, s/he can fit that into her/his already existing knowledge of dogs, and her/his knowledge of the types of dogs there are grows. Accommodation allows for change. Accommodation is the act of the organism reaching out into the environment and adjusting to new conditions in the environment, so

that already existing cognitive structures are modified to cope with the new information. Accommodation uses an existing knowledge structure to figure out a new situation. For example, a young child who sees a cat may call the cat a dog, if s/he has no previous knowledge of cats. When told the animal is not a dog, it is a cat, s/he must then either disregard the new information or reorganized her/his thought structures to accommodate the new classification of cat. Assimilation and accommodation go hand in hand, and must always work together. The act of adapting assumes an underlying organization, which is the second basic learning characteristic and functional invariant. Organization is the ability to combine physical and psychological schemes into coherent systems. Organizations are created through adaptation (Flavell 1963, 45).

Being a biologist, Piaget developed a biological theory of knowledge. He was the first to take epistemology out of the philosophical realm and described it as being a part of biological growth. The ability to adapt to new situations through self-regulation is the common link between all living things and the basis of his biological theory of knowledge. He felt that at certain ages the child exhibits characteristic structures or organizations of action and thought. He called these periods or stages (Pulaski 1980, 16). Piaget's stages are divided loosely by age. The first stage is the sensorimotor which is from birth to about 18 to 24 months of age. This stage is characterized by the infants use of her/his senses and motor skills to learn. It is during this time that schemas are being developed from which later cognitive growth will be built. Objects are always assimilated to something and that something Piaget called

a scheme. A scheme is an organized pattern of behavior or thought (Cohen, Horak, and Stanley 1989, 38). It's a way of classifying and organizing the environment. Examples of schemes in infants are sucking and grasping. Schemes are discussed primarily in terms of the sensorimotor period, although we continue to develop schemes throughout our lives.

The second stage is the preoperational which is from about two years of age to 6 1/2 or 7. There are several characteristics of this stage. One is the development of symbolic functioning--the ability to represent with one object, another object that is not present. Another is that children in this stage use what Piaget called syncretic reasoning. Their reasoning is not based on logic, but on contiguity. They assume that objects and events that occur together have a causal relationship. For instance, a child may believe that thunder makes the rain (Pulaski 1980, 49). Young children can seem very illogical, but in their minds and in their own thinking they are very logical. Their thinking is very concrete. By really listening to their illogical ideas and their reasoning it can be seen that children are in fact thinking hard about everything that goes on around them and trying to figure it all out. Looking at children's thinking from this point of view, there are no "wrong" answers. The answers that they come up with are "right" for their stage of cognitive development. As Wadsworth states, "The child's placement of stimuli into schemata is theoretically always appropriate for his level of conceptual development. There is no 'wrong' placement. There are just better and better placements" (Wadsworth 1979,18). Another characteristic of this stage is egocentric thought, or what Piaget later

called decentration. Piaget rejected the term egocentric in his later writings because of its misleading connotations of emotional self-centeredness. This was not what he meant by egocentric. What he meant was that both literally and figuratively, the child can see things only from her/his point of view. Children do not take other points of view into account because they are not yet capable of doing so. He did not mean that children only care about themselves and no one else. He meant that the young child can interpret new experiences only in terms of her/his own experiences, needs, and desires.

Play and imitation are very important aspects of the preoperational stage. Play is based on assimilating reality. Imitation is based on accommodating reality. In play, children symbolize or pretend; in their minds they change the object they are playing with into something else. This is the essence of assimilation. Children are active learners in a very literal sense. "In play, the child is practicing the various actions that will eventually be internalized as thought. . . . what children acquire through active manipulation of the environment is nothing less than the ability to think" (Elkind 1970, 53). I agree very much with this statement. Piaget points out that children comprehend physical phenomena by assimilating them to motor activity and that assimilation in its purest form is play (Piaget 1977, 155). Play is vastly underrated by traditional educators--they do not believe that play has an educational function. In this they are very wrong. Play for young children is an important part of their developmental process--it is their learning. The opposite side of play is imitation. With imitation children are copying others movements

and speech--they are totally accommodating to the environment in order to learn. Accommodation in its purest form is imitation.

The third stage of development is the concrete operational which is from ages 7 to 11 or 12. This stage is characterized by the child's ability to reason. The child is able to now take the symbolic thinking of the previous period and use it logically. Her/his thought becomes operational. It can operate, so to speak, on problems, to figure them out. Operations have to do with the organized, structured, reversible, interiorized activities of the mind (Pulaski 1980, 234). Thought is now reversible--it can be mentally reversed. For instance, if A plus B equals C, then B plus A must also equal C. Reversibility is also applicable with conservation of objects. Conservation is the ability to understand that a quantity of matter stays the same even though its appearance may change; that one cup of water is the same amount whether it is in a tall, thin glass or a short, fat glass; that the amount of two equal lumps of clay is the same whether the lumps are in the shape of a ball or the shape of a snake. Before this stage the child did not have the ability to reverse operations. Preoperational children will say the amount changes with shape. These processes involved in reversibility are called centering and decentering. The preoperational child centers on the difference in appearance in the equal amounts of clay. All s/he can see is the dramatic difference in appearance. The operational child decenters--s/he notices other aspects of the clay that conflict with her/his original impressions. S/he will eventually realize that changes in length are balanced by inverse changes in width (Pulaski 1980, 32). This stage is called concrete operational because

operational structures are formed by manipulating objects, including physical objects, people, events, and emotions. Although the construction of concrete operational structures requires the manipulation of objects, once the structure is formed it can then be used even with objects that are not present (Cohen, Horak, and Stanley 1989, 38). The child now has the ability to organize her/his thoughts and arrange them in relationships.

Piaget stated that "knowing is action on objects." Children who do not have adequate experience with concrete materials will not develop adequate mental operations. He felt that children in traditional schools suffered from "cognitive passivity." I think by this he meant that children who are not allowed to use concrete materials and really use their minds to figure out problems, become mentally passive or lazy. They need to take an active part in discovering facts and figuring out relationships in order to develop their cognitive abilities (Pulaski 1980, 141). Piaget states that the budding operations, ". . . are still applied solely to objects, not to hypotheses set out verbally in the form of propositions (hence the uselessness of lecturing to the younger classes in primary schools and the necessity for concrete teaching methods)" (Piaget 1977, 32). This seems so logical and makes so much sense to me that I do not understand why traditional schools continue to teach by lecturing, especially with young children. Their whole beings call out for action. Instead of taking advantage of the child's natural inclinations, we make the value judgement that those inclinations are not productive, and try to mold the child into adult behavior.

The last stage of development is the formal operational, starting at about age 11 and lasting through adulthood. It is not until this stage that cognitive structures become integrated into a single, coherent system. The child is now capable of thinking about hypothetical problems, as well as real, concrete problems. This stage is characterized by the child's ability to think about her/his thinking. The operational structures of this stage are developed from the structures formed during the concrete operational period (Cohen, Horak, and Stanley 1989, 39). This is why it is so important to give children the time to develop in each stage and not rush them. If they are allowed to develop fully, they will be able to move on successfully to the next stage. Earlier is not better. Later is better if later happens because the child is allowed to explore the environment and construct her/his own cognitive structures. Eleanor Duckworth, a colleague of Piaget's, emphasizes the need for time in children's learning. She discusses learning with "breadth and depth". Breadth is the many different kinds of experiences we can have that we can then relate to each other. Depth is the many different connections that can be made among the different facets of each experience. Learning with breadth and depth is totally different from learning with speed. A child who spends time exploring all of the possibilities of an idea will stay with it longer and move to the next stage less quickly, but when s/he does move on it will be with a better foundation for continued learning (Duckworth 1987, 70). Duckworth feels, and I agree, that children need time for their own confusion; that putting ideas into relationship with each other is confusing and that confusion takes time to work out. Children are

not at all interested in being hurried. In my work with children, I see them become very involved in finding out the physical properties of substances; in the relationships of objects to each other; in our small reptiles and insects, what they look like and how they interact with the environment. When they do these things they are never in a hurry. They become involved, focused, and passionate about what they are doing. This is when real, lasting learning takes place.

This brings me to what Piaget called, "The American Question." This question is, of course, "Can cognitive growth be accelerated?" I say, "of course," because it seems that in this country, faster is thought of as being better. There have been various studies in this area. Some have shown that cognitive development can be speeded up to some degree. However, "the nature and extent of the subject's progress was always, in fact strikingly so, dependent upon their initial development level" (Pulaski 1980, 200). In other words, these children may have been "ready" to move from one level to another. What has been found in learning research done in Geneva in the late 1950's is that teaching the child a "rule" about why something happens, without internal understanding, does not speed up cognitive growth. For instance, teaching children the "rule" that the snake-shaped clay has the same amount of clay as the ball-shaped clay does not speed up their understanding of what is really happening with the clay. And this is what we do over and over in education. We teach children "rules" to be regurgitated back to us with out teaching understanding. When we do this we are not taking into consideration the way in which children construct their own

knowledge. We are again treating children as if their minds are empty waiting for knowledge to be poured into them. The child's understanding comes with the her/his struggle to make sense of the data. Here again, the child constructs her/his own knowledge. The "speeded up" learning that was done in this research study took time, was not universal, and was not able to be generalized. Piaget conceded that, "a certain amount of learning of logical structures can take place." He questioned though the reasons for doing so. The question for him was not how fast we can help intelligence grow, but how far we can help it grow (Duckworth 1987, 38).

Piaget believed there are four factors that drive the structural changes from one stage to another and allow for cognitive growth. The first is the maturation process. As the child grows and matures s/he becomes more aware of and interested in the outside world. S/he wants to know the why and how of the world and sets out to explore and experiment. This is related to the growth and development of the nervous system. Changes in the nervous system occur at different times in a person's growth. These changes are necessary before various mental processes can occur. It needs to be pointed out, however, that the maturation of the nervous system does not drive intellectual growth. It simply allows for possibilities of growth. The development of the cognitive structure is dependent upon the experience of acting upon objects by the child (Piaget 1977, 36). This brings us to the second factor that contributes to the child's cognitive development--her/his experiences. Through the child's experiences with objects, s/he constructs her/his knowledge. There are two kinds of knowledge constructed from the child's experiences.

One is physical and the other is logical-mathematical. Physical knowledge is knowledge obtained by observation. Physical knowledge involves how objects act or are transformed. Logical/ mathematical knowledge is knowledge the child acquires as s/he acts on an object. This knowledge has to do with the relationships which exist, not in the objects themselves, but in the mind of the child who compares them (Pulaski 1980, 12). Children must be allowed to do their own learning and form their own relationships. Learning is then internalized, which is the only way learning can really occur. The third factor that drives structural change is what Piaget refers to as social transmission. This is simply information learned from others or from books. When a child hears contradictory information her/his equilibrium is upset and s/he then looks for answers that will help her/him regain equilibrium.

The fourth and last factor in cognitive growth is the equilibration process which coordinates and regulates the other three factors. This factor was stressed by Piaget and brought up again and again in his writings. It is the main mechanism of change from one level to another. Equilibration is a balance between assimilation and accommodation. It is the act of balancing changes brought about by accommodation and assimilation to arrive at equilibrium. Equilibrium, of course, can never last. Maturation, experience, and social transmission are continually at work to upset equilibrium. Equilibration, in fact, must be upset in order for learning to occur. Since children live in a world where they are constantly receiving new input, new conflicts and questions are always coming up. The child, as a part of everyday living, is constantly in a state of

assimilation, accommodation and equilibrium. S/he is always learning (Pulaski 1980, 12; Cohen, Horak, and Stanley 1989, 39). It is through this learning that children construct their own knowledge. "Once we acknowledge that children are learning something, all of the time--even if it is not what we set out to teach them--then we have considerably broadened our options for teaching children and for directing their mental growth" (Elkind 1970, 123). This, I believe is the crux of the problem in education. We need to look at children and learning from a whole different angle, a different paradigm. When things aren't working educationally in this country the education system has a tendency to do more of exactly what they've been doing, only harder. Instead of continuing to teach the way we do, only more of it, we need to teach in a totally new way. We need to really look at children and listen to what they tell us about the way they learn by truly observing them and learning from those observations.

There are certain points about Piaget's stages that need to be made clear. Much research substantiates the theory that the sequence of the stages is invariant--they always occur in the same order. This is due to the fact that each stage is incorporated into the next one. This does not mean that a person must be, for instance, at the concrete operational stage in all areas of learning before s/he can be at the formal operational stage in any one area. A person may be concrete operational in math and formal operational in music. Another point is that the stages are not clear-cut and well defined. The process of going from one stage to another is gradual and continuous. Piaget has been misunderstood on this point. Other

psychologists and educators have taken the division of ages as having hard and fast lines. They believe that certain structures must be learned by certain ages with little or no variation. They do not take into account that children are individuals. The important point is not that children show certain structures at specific ages, but that the stages of development evolve in a broad, continuous sequence (Pulaski 1980, 18). The last point to be made is that old structures are never lost and can be called upon when needed. If a person is formal operational in an area, s/he is still capable of using concrete operational structures in that area, if needed (Cohen, Horak, and Stanley 1989, 39).

Harry Beilin, a developmental psychologist at the City University of New York, gives several reasons for Piaget's theory continuing to have considerable influence in the field of developmental psychology. One is that Piaget's theory represents a basic constructivist view of development that will always have a place among developmental theories. Another is that this theory is developmental to the core. Even if this theory is not one that everyone agrees with, it requires by the fact of its existence that other theories offer alternative explanations of developmental change. A third is that it is built on both structural and functional explanations of cognitive development and is still the best theory to integrate both. Theories that emphasize one to the exclusion of the other are incomplete. A fourth is that Piaget's extensive experiments will keep cognitive investigators busy for decades. There are many, many experiments still to be translated and investigated. Last was Piaget's interest in epistemological matters to which he felt

developmental psychology gave important insights (Beilin 1992, 191).

Beilin states that no one has had a greater impact on developmental psychology than Piaget; that his theory has no rival in both scope and depth; and that his theory has maintained a continuity in most of its core assumptions. An anonymous reviewer of the draft of Beilin's article, "Piaget's Enduring Contribution to Developmental Psychology," observed that "assessing the impact of Piaget on developmental psychology is like assessing the impact of Shakespeare on English literature or Aristotle on philosophy--impossible. The impact is too monumental to embrace and at the same time too omnipresent to detect" (Beilin, 1992, 203). I agree with this assessment of Piaget. The breadth and depth of his work is overwhelming. A person could spend a lifetime studying just one small aspect of his theory. I have found it fascinating. I believe the importance of Piaget's work is that he gave psychologists and educators a whole new way of looking at children and learning. He showed how children build their own cognitive structures and how important the early structures are for the building of later structures. He showed that pushing children into abstract work at an early age is not only unproductive, it is harmful. He showed, for the first time, how children learn by constructing their own knowledge.

Before researching Piaget for this chapter I believed his theories were not as valid as once thought. What I found was that his theories are extremely valid and still very much in the forefront of developmental psychology. I have found his theories still being discussed in recent books on children's learning and that his work is

still being translated and debated. We need to continue looking to Piaget's work in order to make education work for children. We need to do this for society, as well as for children.

> If we desire, in answer to what is becoming an increasingly widely felt need, to form individuals capable of inventive thought and of helping the society of tomorrow to achieve progress, then it is clear that an education which is an active discovery of reality is superior to one that consists merely in providing the young with ready-made wills to will with and ready-made truths to know with (Piaget 1977, 26).

I learned a tremendous amount in researching the literature on Piaget. The research for this chapter gave me an understanding of Piaget's stages and how children develop. More importantly, it began to answer my question of <u>how</u> children learn experientially. Piaget's research on how children construct their own knowledge contributed greatly to my knowledge about the way in which children learn experientially. Children not only learn by constructing their own knowledge, they must do so <u>experientially</u>.

CHAPTER 3

MAKING USE OF PIAGETIAN RESEARCH AND ASSESSMENT TECHNIQUES

In this chapter I will be discussing the criticisms and strengths of Piaget's theory, as well as the strengths and limitations of his clinical method. I will do this in the context of a comparison of Piagetian assessment methods and behavorist assessment methods. I feel there is a need to compare these two methods for the following reasons. One is that Piagetian assessment methods are what I used in my research study. Behaviorist assessment methods are those most often used by educators and I feel it is important to point out the differences in the two. I also feel I need to do this comparison in order to give a clear picture of why the use of Piagetian methods is important in understanding how children learn experientially. I want to point out in this chapter the importance of using Piagetian methods for research rather than for assessment. I did not use Piaget's method for the purpose of assessment. I used it to help me understand how children reason and construct their own knowledge. It also needs to be pointed out here that although Piaget develop the clinical method he did not consider it a formal approach to assessment; he looked at it as a qualitative research method. It was later developed as a more formal assessment method by his followers.

Piaget's theory is unconventional and controversial. It follows that there are many criticisms as well as many strengths in his theory. One criticism is that many of Piaget's studies are merely vocabulary-growth studies. This I do not agree with. His tasks are clearly more than just a reflection of a growth in vocabulary. Although vocabulary is certainly an important aspect of the tasks in using the clinical method, it is really a vehicle to explore what the child is thinking and why s/he is thinking the way s/he is. Vocabulary growth change is a consequence, reflection, or symptomatic expression of underlying and fundamental cognitive change (Flavell 1963, 434). Flavell feels that the fundamental question is not whether vocabulary growth is taking place, but whether there are other cognitive changes taking place and what the relationship is between those cognitive changes and vocabulary.

Early critics had the impression that stage characteristics are confined to particular ages. This is actually still a problem today. People have a tendency to want to fit behavior into nice little pigeon holes--to say these behaviors go with these ages with no variation. Piaget made it clear this is not so. There is much flexibility in the ages at which cognitive behaviors occur. The invariable is the order in which they occur.

Piaget's model of assimilation and accommodation is one of his theory's many strengths. It gives a continuity to his theory of cognitive development that progresses from birth to adulthood. There are similarities and a connectedness between all types of learning, from such different activities as the sucking reflex, to adolescent scientific reasoning. Both activities have organizational

characteristics and consist of an assimilation/accommodation process. It is this process that is used to construct knowledge. There is an assumption that the development of cognition is more than anything else a constructive process, and that this development has a cyclic character (Flavell 1963, 408). This cyclic character has been described as the "spiral of knowing." The construction of knowledge is integrated and reorganized in higher, more complex structures of logical thought. This thought, in turn, becomes part of the hierarchy of abstract thought. Each level of cognitive functioning builds on the lower levels and contributes to higher levels in an ever-widening and encompassing spiral of knowing (Pulaski 1980, 29).

Equilibration, a part of the assimilation/accommodation process, permits comparisons and contrasts of different levels and kinds of behavior with a common yardstick; it allows for comparisons between intelligence and perception; and it is able to account for cognitive changes in which there is no direct feedback as to correctness of response (Flavell 1963, 409). This theory of learning makes so much sense to me both in terms of what I feel instinctively about children's learning and in terms of what I know from working with children for twenty-four years, both as a teacher and a parent. I can almost see the wheels turning in a student's head as s/he works with materials in science to try and figure something out. The assimilation/accommodation/equilibration process also feels familiar to me as a process that I myself experience.

Before Piaget there was no developmental psychology to account for children's learning and intellectual growth. Piaget's studies revealed that the way in which cognition develops has

unsuspected and extraordinary richness. His theory of how children construct their own knowledge gave us a way of understanding how children learn that we did not have before. He gave a detailed picture of the cognitive development of the child which gives an historical frame and perspective to view the adult. This is something I had not thought of before. If we accept Piaget's view of child development, we then have to look at adult human behavior and learning in a new light. Piaget's is the richest amount of theory and data on intellectual development available. It is the only really detailed stage-analytic theory in existence (Flavell 1963, 411).

The most thorough description I have found of Piaget's clinical method is in Piaget: With Feeling by Philip Cowan. He felt that Piaget's main question in developing his clinical method was, "How should we go about collecting and interpreting data so as to construct a comprehensive and useful theory about child development?" (Cowan 1978, 59). Cowan goes on to compare the behaviorist point of view and Piaget's point of view. Piaget rejected the behaviorist claim that only observable events were open to scientific study. He believed that cognitive behavior could and should be studied scientifically. In a behaviorist model all scientific tests, observations, and experiments must be systematic rather than random, public and easily communicated rather than private, and repeatable over time and across situations by different experimenters. Piaget accepted these requirements, but not the ways of obtaining them. He questioned the so-called objectivity of the behaviorist's methods (Cowan 1978, 60).

Behaviorists rely on three methods to establish objectivity. These methods are testing, naturalistic observations, and experiments. They use the information obtained about the relation between the stimuli observed and the responses observed, for their findings. Piaget felt it was also important to include the child's and the experimenter's interpretation of the events happening in the experiment. Piaget did not believe the above three methods could be completely objective for several reasons. The first reason has to do with tests. The two primary traditional tests for children are the Wechsler Intelligence Scale for Children (WISC) and the Stanford-Binet. Piaget felt that there is both a theoretical bias and a cultural bias in the selection of items on traditional tests. I agree with this. Traditional tests are theoretically biased with a behaviorist point of view. Test items are chosen with the behaviorist's goals in mind. They are content rather than process oriented. There is definitely a cultural bias in that most tests are aimed at the knowledge that white, middle class children have (Cowan 1978, 64). Also, there is a difference on traditional tests between how well males and females do. Females tend to do better until adolescence and at that point males do better. Piagetian tests show few differences in performance based on gender. Traditional tests lean heavily on verbal and reading skills. Piagetian tests maximize reasoning ability, which I feel is truly a test of intelligence. Piagetian tests are also more culture-free than traditional tests (Wadsworth 1978, 229). They use simple materials most children are familiar with and for the most part, content that would be known in some cultures and not in others, is not tested.

The second reason Piaget questioned the objectivity of traditional tests is that when there is a standard administration of the test the "natural mental inclination of the subject" is falsified. By this he meant that these tests measure the content of the child's knowledge, but not the reasoning behind their correct and incorrect answers (Cowan 1978, 64; Wadsworth 1978, 221). The emphasis is on content and what the child already knows. Flavell states, "Exclusive preoccupation with content development may have its uses, but it is a dull and profitless pursuit for anyone with more macroscopic and theoretical interests in intellectual growth" (Flavell 1963, 409). I think this is a great quote. It points out the narrowness of content-oriented learning and testing.

In the WISC and Stanford-Binet tests there is always a standardized procedure. The main interest is primarily in the correctness of the answers and that the responses can be compared to the set norm for the age. Piaget felt and I agree, that in order to determine a child's reasoning processes unstandardized interviews must be used. Also, standardization of stimuli and test administration really only exist from the point of view of the experimenter. The same questions given to a group of children may, and probably do have different meanings for each child. I very much agree with this. Children interpret questions according to their own experience. Since they all have different experiences, there are going to be different interpretations. There is no purely objective test, because all tests are developed by people, and people can never really be totally objective. Another problem with the objectivity of traditional tests is that the child's performance is influenced by

many factors such as how s/he is feeling that day and her/his interest in the test. The rationale behind the standardization of tests by behaviorists and other psychological researchers is for the purpose of replicating results. Piaget's unstandardized clinical method has produced some of the most replicable results in the field (Cowan 1978, 64).

It is considered important by behaviorists for tests to have both reliability and validity. Reliability is the consistency with which the test measures--the results would be consistently the same for a child tested several times. Validity is whether the test really measures what it's supposed to measure (Wadsworth 1978, 220). The WISC and Stanford-Binet meet both of these criteria. I believe the Piagetian tasks also meet these criteria. Piagetian tests have been shown to be consistent when a child is tested several times on the same or similar tasks. I believe Piagetian tests are, in fact, much more rigorous in some ways than traditional tests. Children must justify their answers, as well as being able to transfer knowledge to other similar tasks. In order to be considered at a specific reasoning level or stage the child must: make a "correct" judgement; logically justify that judgement; successfully resist a verbal counter-suggestion; and produce a successful performance on a related behavioral task. A counter-suggestion must be made in order to determine if the child really understands the concept. A child might give a correct answer for many reasons: s/he knows the answer and understands it; s/he guesses at the answer; s/he is cued to the answer by the examiner; or s/he remembers something that cues her/him to the answer, but without real understanding (for example,

rote memory). Also, children may understand the concept but give an incorrect answer for several reasons: they don't understand the question; they aren't motivated or interested; they have fear and anxiety about the situation; or they are preoccupied with something else (Wadsworth 1978, 226). Piagetian tasks really explore a child's understanding in order to avoid these problems.

The second method used for the purpose of obtaining objectivity is naturalistic observation. Traditional and clinical methods are similar in the use of naturalistic observation. Piaget felt that this was just a starting point, although a necessary one. He felt children must be observed without interference, in order to get a perspective on what children's interests are and how they find solutions to their questions. He did not feel that it could be the only method for obtaining data (Cowan 1978, 64). In the purely observational method of testing, the observer records or takes notes of the children's spontaneous statements and questions. The information received is structured by the child rather than by the observer. The drawbacks to this method are: the observer may need to ask questions; there is difficulty in distinguishing play from beliefs; and it is time consuming and cannot be used on large numbers of children (Cowan 1978, 65; Wadsworth 1978, 222).

The last method used for the purpose of obtaining objectivity is experimentation. The object of experimenting is to test or observe, then to systematically manipulate one variable, and then to test or observe again. This can be done with large numbers of children or with a single child. Experimentation is usually thought of as a way of testing hypotheses, though many times it is simply a way of

validating an experimenter's interpretation. In experimentation, as well as testing and observation, Piaget again did not feel it was possible to gather and interpret data totally objectively (Cowan 1978, 65).

Piaget felt that standardized tests and pure observation were inadequate for judging children's reasoning. He felt a method was needed that has the advantages of the observational method and avoids the drawbacks of standardized tests. He thought that the behaviorist idea of the experimenter as a passive observer ignores the hypothesis that children are actively involved in constructing their own learning. The clinical method, developed by Piaget, has the specific goal of determining the how and why of a child's reasoning. This method was exactly what I needed in order to help me understand how children learn experientially and construct their own knowledge. Piaget developed what Cowan describes as the triangulation approach. This approach is open to the possibility that both the child and the experimenter are attempting to understand the same event. In figure 1, questions are used to explore the child's version of the event (CA) and the child's version of the experimenter's questions (CB). The experimenter compares her/his own interpretation with the child's to arrive at a coordination of events at A, B, and C. The behaviorist method would limit the experimenter to the AC side of the triangle, simply describing the object at A and the child's response at C.

A event

experimenter B C child

figure 1

This diagram shows, though, that the description would be primarily the experimenter's version of the event (BA) and the experimenter's version of the child's response (BC). Behaviorists have a very self-centered approach in that they totally control the experiment and are under the illusion that they are unbiased. Because of this, they end up introducing unseen bias into their observations and conclusions. The clinical method has a much less self-centered approach in that the experimenter follows the child's answers with questions that fit that particular child and situation. The experimenter is also aware that there may be bias and can therefore deal with it (Cowan 1978, 66).

Some of the major criticisms of Piaget's research methods have to do with his experimental design and data analysis. Piaget did not conduct and report research in a way that makes a convincing case for traditional researchers. He failed to establish and report in what was considered to be a scientifically acceptable way and he failed to give a clear and full account of exactly what he did in an experiment. In his organization and analysis of data he had excellent qualitative data, but no real quantitative data such as response level (stage and age) and age distribution at each stage. He rarely used graphs, charts, or statistical tables. Instead, he selected a few typical concrete examples to describe the behaviors in a stage. Many times

he neglected to include the size of his sample and the exact characteristics of the experiment. It was because of these omissions that his experiments had the image of lacking in scientific sophistication. Piaget was satisfied with convincing himself about how children learned and basically he played by his own set of rules (Cowan 1978, 74, Flavell 1963, 429). I think what this really means is that he had a different set of assumptions about learning than traditional psychologists. This may be why people do not always understand what Piaget is saying and do not know why they don't understand. I also believe that what researchers really don't like isn't so much that Piaget didn't get verifiable results--he did. I think what they don't like is that he didn't play by their rules. It should be pointed out here that Piaget did not think of his method as a formal approach. It has been developed as a formal approach to different degrees by his followers.

The criticism that Piaget's studies lack scientific sophistication is disproved by the fact that Piaget's tasks were and continue to be repeated with other children and other experimenters. This is consistent with the behaviorist approach. His experiments are some of the most widely replicated in the field of developmental psychology. Because of the extensive use of Piagetian testing, there has been an increased standardization of Piagetian tasks based on interpretable and replicable findings. This does not preclude flexibility for the experimenter. There is still plenty of room for the experimenter in the use of materials and questions used with a particular child. Despite the flexibility of Piaget's method, his results have been replicated by experimenters in many countries. This

replicability is, in fact, impressive because of its flexibility (Cowan 1978, 74).

Traditional testing measures a wide range of abilities: verbal, specific facts learned, visual skills, and motor skills. Piagetian testing primarily assesses reasoning ability with respect to concepts children have learned without direct instruction. The interpretation of Piagetian results are reasonably clear and based on Piagetian theory. Traditional tests are not based on a particular theory and do not allow for the range of exploration that Piagetian tests do (Wadsworth 1978, 227). Piagetian tests are more thorough and insightful. It is the measurement of reasoning vs. the measurement of content. What we're really talking about here, depends on what you're interested in and what your goal for children is. If the goal is merely learning content, then traditional tests will test for this to some degree. If the goal is learning to reason, then Piagetian testing will assess this. It is important to remember that a Piagetian assessment is not a set of tasks. It is primarily a method and philosophy of assessment. With an understanding of the assessment method and philosophy the examiner can create her/his own tasks and procedures. There is never a fixed set of questions (Wadsworth 1978, 223).

The clinical method is not so different from the behaviorist's in its methods, as in its research strategy in combining tests, observation, and experiments. Piaget's intent for the clinical method was to support a fully scientific study of the child. His method is public and repeatable across situations and over time. It has similar results when used by different experimenters. The key word for the

clinical method is "systematic," replacing the behaviorist emphasis on "objectivity" (Cowan 1978, 75). The clinical method is systematic and thorough as opposed to being merely objective. Traditional tests deal with the quantitative aspects of intelligence, correct answers, and individual differences with the rate of development being compared with the peer group. The clinical method deals with the qualitative aspects of intelligence, the reasons for correct and incorrect answers, and universalities in the sequence of stages. Each has different questions and methods and so consequently, each leads in different directions (Cowan 1978, 78).

Intelligence is a psychological construct. This means that we infer its existence from behavior. Performance on tests is one type of behavior. I do not believe in many of the reasons for testing. It seems to me that one of the main purposes of testing, at this point in time, is to categorize or label students. I feel that labeling students gets in the way of their learning. Another negative result of testing is the competitive nature of tests. The end result is that some children feel like winners, while a great many feel like losers. Connected with this is the stress that testing produces in children, even those who do well on tests. The behaviorist goal in testing is prescriptive. It is done for the purpose of diagnosing a "problem" and finding a "solution." The Piagetian goal in testing is descriptive. It is done for the purpose of describing behavior. The child is accepted for functioning at her/his present cognitive level. There are no value judgements about the stage the child is in at the time. In referring to traditional and Piagetian assessments in this paper, I have called them both tests, but I do not think of Piagetian tests as

tests in the usual sense of the word. I think of them as simply learning activities used for the purpose of helping me better understand how children think, so that I can better meet their needs as a science teacher.

Piaget felt that sophistication of the quest for knowledge, rather than the correctness of response should be used to define the child's intellectual level. Using the clinical method in the classroom can change the way we think about children. It helps redefine what a test should be--a way of stimulating the highest level of understanding in a child, rather than simply evaluating successes and failures. I believe traditional testing gives a very narrow view of the child. Also, studies show that teachers have lower expectations of children who they think have scored lower on tests, the effect being that those children live up to those lower expectations. Another positive aspect of the clinical method is that the clinical interview tends to be validating for children because the tester shows a genuine interest in what the child really thinks. Using this method can provide a model of communication that may carry over into children's interactions with each other. Adults who make a real effort to understand children are modeling a positive way of exchanging points of view (Cowan 1978, 82).

The clinical method is more difficult to use than traditional tests. It is more time consuming to do and takes time to learn. Time, as in other areas in education, is again a factor. We like things quick and easy. But as in the other areas that take time, it is worth it to learn to use the clinical method.

> The good experimenter must, in fact, unite two often incompatible qualities; he must know what to observe, that is to say, to let the child talk freely, and later, manipulate objects freely, without even checking or sidetracking his utterances, and at the same time he must constantly be alert for something definitive. At every moment he may have some working hypothesis, some theory, true or false which he is seeking to check. To appreciate the real difficulty of the clinical method one must have taught it. When students begin they either suggest to the child all they hope to find, or they suggest nothing at all, because they are not on the lookout for anything, in which case, to be sure, they will never find anything (Piaget 1926, 8).

The clinical method is unique in that it doesn't just assess what children already know. It allows the experimenter to see the child involved in the process of acquiring new understandings. I believe this method is a thorough method of really discovering a child's intellectual development. It is a true test of intelligence. It is a fairer method for the child because it gives the most opportunity to display knowledge and is designed to bring out the highest levels of thought (Cowan 1978, 73).

The research for this chapter helped me have a better understanding of the <u>use</u> of the clinical method. It is a very narrow view to look at Piagetian assessment merely as a way of defining the stage a child is in. A broader view is to use this method, not for assessment, but for research purposes to learn more about how children reason and construct their own knowledge. In this way we can learn more about how children learn experientially. The research involved in obtaining information on Piaget's clinical method gave me the <u>tool</u> I needed in order to do my own research on how children reason and construct their own knowledge.

CHAPTER 4

AN EXPLANATION, DESCRIPTION, AND RATIONALIZATION OF THE RESEARCH

In this chapter I will discuss the rationale for using Piaget's clinical method in my research study. I decided to do a Piagetian-type study for several reasons. One was that I became very interested in the clinical method itself and wanted to verify for myself whether children really reasoned in the way Piaget described; whether a young child really thought that the clay became bigger when it changed shape; whether there really were stages of development and at what operational level a child was at what age. Another was to better understand Piaget's findings, so that I could then use this information to help me set up and run a better experiential science program. I wanted to come to a better understanding of how children construct and structure their knowledge and how children learn experientially. A last reason was that in reading about Piaget and work by others about children's theories and reasoning I became most interested in finding out for myself what children's reasons and explanations were for what they see happening when they do science activities. Piaget's focus on children's reasons for their wrong, as well as their right answers, was most intriguing to me.

I decided to do several Piagetian tasks with six children ranging in age from five to twelve. I chose two Kino students, based

upon their ages, from each of the following stages: preoperational, concrete operational, and beginning formal operational. These students were chosen based upon their age, time enrolled in Kino, and whether they wanted to participate. I chose students who had been enrolled in Kino for several years to insure they would be able to be involved in this project for the full school year. I did not want to choose newer students who might leave Kino mid-year. I also chose one male and one female from each of three age groups. The children I chose were: C1, female, age 5 years, 5 months; C2, male, age 5 years, 9 months; C3, female, age 8 years, 2 months; C4, male, age 8 years, 11 months; C5, female, age 10 years, 8 months; and C6, male, age 12 years, 11 months. These were the ages of the children in September, 1993.

This practicum evolved in a different way than I had originally planned. I was going to do the concrete operational tasks with the five to eight year olds and do the formal operational tasks with the two older students. As I was doing the concrete operational tasks with the younger students, I realized that I also needed to do them with the older students in order to compare their reasoning. I also decided to do some of the formal operational tasks with the eight year old students in order to compare their reasoning with the two older students. I started with the youngest children and did concrete operational tasks with them. I then did the concrete operational tasks with the older children. I later did the formal operational tasks with the oldest children and then did some of the formal operational tasks with the younger children. I worked with each child individually for about twenty to thirty minutes at a time.

The interview process is very important. Critical to the correct use of the clinical method was an understanding of Piaget's theory. Mastery of the clinical method comes with doing it (Wadsworth 1978, 223). I feel I had a reasonably good understanding of Piaget's theory when starting this practicum. I understood the clinical method as well as I could without having actually used it. I read extensive background information on Piaget and his theory. I read interviews, and throughout my practicum continued to read interviews, about children working on Piagetian tasks in order to understand how to conduct interviews for the different tasks. I read books, chapters from books, and articles on children's reasoning, which helped me immensely. Some of these did not describe Piagetian interviews, but described dialogue between children and teachers and children with each other, with a discussion about the children's reasoning. Other books and articles I have read did not so much describe the steps of the Piagetian interviewing process, as much as to give examples of the process. As all interviews with children were individualized, there were no specific steps to follow and, in fact, it would have been contrary to the interview process to standardize the questions. My training in actually using this method happened as I did it. My field faculty advisor critiqued my interviews and gave me the feedback I needed to improve my interviewing techniques.

It was important to establish a good relationship with each child, so that s/he felt comfortable. I already knew the children I would be working with and had a good relationship with them, so this was not be a problem. Also, the tasks they did were similar to

the science and math activities we do during the school day at Kino. They were not uncomfortable with the materials or their use of them. The difference was that I tape recorded the activity. This did not seem to bother the children. I think, in fact, that they felt important to be part of my study and to be helping an adult with her school work.

The general guidelines for doing an interview are to: accept answers without telling a child s/he is right or wrong; always ask for justification of an answer; hypothesize about how the child might be thinking and ask questions of the child to test hypotheses; allow for wait-time to allow the child time to think; and make it an enjoyable experience for both yourself and the child (Bybee and Sund 1982, 85). I had no trouble accepting the children's answers as they were given. I did find it difficult, at first, to remember to ask for justification when the child answered with a "wrong" answer. This was something I had to work on. This was important because I was interested in <u>how</u> the child was thinking and <u>why</u> s/he was answering as s/he was, whether the answer was "right" or "wrong". Hypothesizing about how the child was thinking and then asking another question to confirm or negate my hypothesis was not difficult. I found myself becoming very focused on what was happening with the child's actions and responses. I have never had a problem with allowing children all the time they need to think about their responses and not hurrying their answers. Making the experience enjoyable for both the child and myself was also not a problem. The students and I enjoyed doing this study. It was extremely interesting for all of us. The students were interested in

the tasks they were doing, some more than others, and they were interested in helping me do this work for my practicum. Watching and focusing on one child at a time while s/he worked on a task helped me tremendously in working with small groups of children on science problems. I became much more aware and in tune to what processes children were going through as they wrestled with a problem. I enjoyed working with children and this gave me a new setting in which to interact with them. Also, I learned along with them which is always enjoyable.

To prepare for the interviews I had to decide which tasks to use with students and spend time gathering and making the materials needed to do the tasks. These materials included beads, blocks, clay, jars, straws, string, weights, a balance scale, and chemicals. I typed up descriptions of the tasks along with transcripts of the interviews. I used a tape recorder to document the interviews and then transcribed them using a word processor. I met with my field faculty advisor to discuss the interviews, which tasks I was using, and what I need to do differently when interviewing.

For this study I used ten tasks for the preoperational and concrete operational stages, and five tasks for the formal operational stage. I used fewer tasks for the last stage because they are more complex and take longer to complete. I also audio taped some of my science groups to use for interpretation of children's thinking. Most of these did not turn out to be understandable because of the noise level in the group and the building itself. I taped one group where the students were not working with materials, but discussing floating and sinking materials activities they had previously done. This one I

was able to understand and transcribe. Although I always ask students questions as they're working with the materials, there were certain questions and responses I audio taped for this practicum. I taped the questions I asked and responses from individual students as they were working with the materials they were asked about.

I will first describe the concrete operational tasks I used. I will include some of the more interesting responses in this description. Three of the most interesting and classical tasks in terms of the children's responses were conservation of substance with clay, conservation of liquid, and conservation of length. In conservation of substance I showed the child two balls of clay that were the same size. I asked the child if they were the same size. If s/he said "no" I asked her/him if s/he could make them the same size. I then rolled one ball out into a snake shape and asked if one piece of clay now had more or less than the other or if they were both the same. Children 1 and 2 said the snake-shaped clay now had more clay than the ball-shaped clay, "Because it's longer" and "'Cause it's rolled out." Child 1 though seemed puzzled by this. When I did this task again with these children at the end of the year they both said the snake-shaped clay had the same amount of clay as the ball-shaped clay, "Because you just rolled it up so some of the insides came out to the outside . . . you didn't take out any clay" (C1) and "Because before they were both the same size with those circles" (C2). The rest of the children said they both had the same amount, "Because you didn't take any clay out or put any clay in" (C5) and "Because you just changed the shape, not the amount" (C6).

In the conservation of liquid task I started with two of the same size jars half filled with colored water. I asked the child if there was the same amount of water in each jar. I then poured the water from one jar into a taller, more narrow jar. I asked if there was the same amount, more or less in the narrow jar than in the original jar still filled with water. I would then pour the water back into the empty original jar and then into a wide, shallow dish. I did the same using four small jars. Child 2 said there was more in the taller jar, "Because it's skinner." Child 1 said there was more in the narrow container, but again was puzzled and couldn't say why. I poured the water back into the original container and then into the four small jars. She knew here that the amount hadn't changed. I then poured the water from the four small jars into the tall container and she got it. She knew it was the same amount, "Because those little jars was poured from that big jar into that" (pointing to the tall container). At a later date, when I was setting up this same equipment for another purpose, C1 said, "I used to think there was more water in the tall jar, but now I know it's the same." Child 4 said there was still the same amount of liquid when poured from one container to another, "Because these are just smaller containers, so you have to have more of them to make one of these (tapping on the larger jar). And I didn't see you spill any. I saw a thing on "Saturday Night Live"--they were trying to reshape the deficit. I think you were trying to reshape that can of water" (C4). These statements tell me that these children know precisely what is happening with the water.

Conservation of length involved five dowel rods, two of which were the same length. The child was asked to choose the two rods that were the same length. The rods were then placed parallel to each other on a table so that their ends were even with each other. The child was asked if the rods were the same length to confirm s/he knew they were. One rod was then moved a few inches to the left of the other. The child was asked if the rods are the same length or if one was longer or shorter than the other. Child 2 said the rod that was moved was longer, "Because this one's down more and this one's up more." The other children said the rods were still the same length because, "You didn't put anything on to it. You just moved it higher" (C1) and "Because they were the same length and all you did was move it" (C3).

Another task I did was one to one correspondence with blocks. In this task I put eight red blocks in a line about an inch apart. I asked the child to put eight yellow blocks in front of each of the red blocks. I asked the child if there were the same number of blocks in each row and how they knew there were. Some of the answers were: "Because they're both in a row" (C2); ". . . because I know that I just took all the red blocks and I can put them in front of all the yellow blocks in the exactly even number" (C4); and "Because they're all aligned with each other" (C6). I then pushed the row of yellow blocks together so that they touched and asked the child if there were the same, more, or fewer blocks in one row than the other. Child 2 said the yellow row had less, "Because the red ones are apart and the yellow ones aren't." Other children said there were the same number in each row, "Because they're in just a more condensed state

and because I counted them by two and I didn't see you take any away" (C4) and ". . . it's the same as the clay, you didn't take anything out or put anything in" (C5). Comparing what she did in this task to another task tells me this child has an excellent understanding of the way in which the amount stays the same regardless of perceptual changes.

In the task correspondence with beads, using an even number of beads, I dropped one bead in a tall transparent jar and one bead in a transparent cup until they were all used. I did this task twice with some of the children because they simply counted the beads in the jar and the cup after I dropped them in. The second time, later in the year, I used the cup and a paper bag. The child could see the beads in the cup, but not the ones in the bag. There were more of a variety of responses on this one. Child 2 did not know if there were more in the bag or more in the cup. Child 1 said they had the same amount, "Because you did one, one, one, one" and "'Cause when you go one in the cup, one in the bag, and when the last one in there (the bag) is the last one, it means that it's even." Child 3 counted the beads as I put them in the cup and the bag and divided by two. Child 6 knew there was an even amount in each container, "Because you started with the jar and ended with the bowl. . . Because if you started with the jar and ended with the jar, there would be more beads in the jar because you'd go from the jar to the bowl to the jar, so you'd have two beads in the jar and one bead in the bowl."

In the task class inclusion with beads I showed the child a transparent cup with two yellow beads and ten red beads. I asked the child how many red and yellow beads there were and what they

were made of. I then asked her/him if there were more red beads or more wooden beads. Child 2 said there were more red beads, "Because there's two yellow beads and ten red beads." At the end of the year this same child said there were more wooden beads, "'Cause they're all wooden!" The rest of the children said there were more wooden beads, "Because the red beads have ten, but they're all wood so if you, the yellow beads are two, but they're wood too, so if you added that all together it would be more than just the red beads" (C4).

The task artificialism was simply answering questions about who they thought made different things. There were various responses to these questions, ranging from God (C1 and C2) to Mother Nature (C3) to scientific explanations from the older children. To the question, "Who made waterfalls?", C5 answered, "Waterfalls? Well, melting ice, rain, evaporation, moving to other places, raining, coming down, making waterfalls. Mainly just ledges, mountains going down, water going down them, which of course makes water fall."

Another task was memory and seriation. In this task I put out ten rods, ranging from one to ten centimeters in length, in a staircase. The rods were touching each other. I allowed the child to look at them as long as needed, took the rods away and asked her/him to draw what s/he remembered. All of the children but one drew the staircase drawing from nine (C3) to sixteen (C1) rods. Child 2, rather than drawing a staircase, drew a sideways pyramid using seven rods. Only the two oldest children drew ten rods and only the oldest had the rods touching each other (he also asked to use a ruler).

In the task perception of liquid level I used a bottle half-filled with colored water with a lid. I showed the child the bottle in five different positions: upright, leaning to the left, leaning to the right, laying on its side, and upside down. I then took the bottle away and replaced it with an empty bottle. I gave the child one paper at a time with a drawing of an empty bottle. Each paper had the bottle in a different position. The child was shown the empty bottle in the same position as the drawing of the bottle and asked to color in what the liquid would look like with the bottle in that position. Child 1 would angle her hand as if she were going to draw the water on an angle, with the jars in the tipped and sideways positions, and then color the water in level with the bottom of the jar. She drew the water correctly in the right side up and upside down positions. At the end of the year I did this task again with her and she drew the position of the water correctly in all of the jars. The rest of the children colored the level of the water in the correct position. I found this curious, as child 1 was concrete operational in most of the other tasks, but preoperational in this task, whereas, child 2 was preoperational in the other tasks and concrete operational in this one. This reinforces Piaget's point that the ages for the stages are only approximate. Both child 1 and child 2 "should" have been preoperational in all areas. Also when I redid the conservation of substance, one to one correspondence, correspondence with beads, and class inclusion with beads tasks with child 2 at the end of the school year, he was concrete operational in these areas.

In the seriation and reverse seriation tasks I used two sets of ten straws cut so they made a staircase. In seriation I put the

longest and shortest straws on the table and asked the child to put the rest of the straws into the correct position. The child was then given the second set of straws and asked to put them into the reverse order of the first set. All the children were able to do these tasks with no problems. All of the children put the straws next to each other to see what their length was and most worked from smallest to biggest. C2 made a sideways pyramid, similar to what he did with the memory and seriation task.

The last concrete operational task was rotation of beads. In this task I used a wire about twelve inches long with a red, a brown, and a yellow bead attached to it and bent at the ends so the beads would stay on it. The child was asked what color the beads were. The wire with the beads was then placed in the top of an opaque tube and the child was asked which bead would come out of the bottom of the tube first. If answered correctly, the tube was then turned one to five times and the child was asked again which bead would come out first. All of the children were able to predict which bead would come out first with responses to the question of which bead would come out first ranging from, "The red. . . because it's in the back" (C2) to "Yellow. . . Because the yellow was on the bottom, then you put it on the top, then you put it on the bottom again" (C3). Child 4 predicted the red would come out first, "Because I followed it. The yellow was up here and I just kept following it with my eyes."

The formal operational tasks I used were: combinatorial logic with liquid chemicals, separation and control of variables with pendulums, proportional reasoning with weights, conservation of volume with blocks, and probability with blocks. I did conservation

of volume and probability with all of the children. I did the remaining formal operational tasks with the three oldest children.

In the combinatorial logic task I used five numbered jars filled with 1) dilute sulfuric acid, 2) distilled water, 3) hydrogen peroxide, 4) sodium thiosulfate, and g) potassium iodine. I showed the student two transparent cups, one containing solution two and the other containing solutions one plus three. The child was not told what the contents of the cups were. I then added several drops of solution g to each of the solutions. I asked the child to notice the reaction in each cup (the cup containing solution two remained unchanged; the other solution turned a brownish-yellow.) I told the child that the solutions in the cups were made from some combination of jars one to four and that each contained solution g. I then asked the child to reproduce the color. Since chemistry is something I really enjoying doing with students, it was very interesting watching the children's reactions and responses to this task. All three children were methodical in their strategies for trying to figure out what combinations of liquids produced the color. They also were interested in continuing with an exploration of the materials even after reproducing the color. C4 and C5 continually talked aloud to themselves as they worked. C6 talked more quietly to himself about what he was doing. All of them wanted to know what the liquids were when they had completed working. This is how C5 started out:

> So, 1 and g isn't it, how about 1 and 2 and g? Nope. How about 1 and 2 and 3 and g. Cool! (Added g plus 3 and got yellow with bubbles) Weird, it's bubbly. God, what is that! (Added 4 to g plus 3) That turned it white! So, what I figured out so far is that 3 and g make yellow and 3 and g and 4 makes bubbly white. So 4 won't work, but 3 might work. But this isn't

> bubbly (referring to the original liquid). This will be my trash cup. That's so strange. 2 is oil. (Added 2 to g and 3) Maybe it's just plain water. Anyway, this doesn't do it. Okay, so 3 and g plus 1. Here, this is working. Let's see if it purifies everything (putting 4 into colored liquid). Cool! This four stuff is neat. I wonder what it is. Anyway, it shouldn't be fun, I should be working.

I assured her that fun and work could be the same thing. This was one of the favorite tasks for these students.

A second formal operation task was separation and control of variables using pendulums. Again, this task was done with the three oldest children. Varying weights were used with varying lengths of string. The child was asked to determine what variable or variables affect the period or the number of swings in a particular time period. C4 used his stop watch to time the length of the period. He had "races" with the different weights on different lengths of string. He designated the winners as being the weights that stayed in the air without coming forward for the longest period of time. So the "winners" were actually the slowest. He never really succeeded in separating the variables of the weight of the pendulum and the length of string. He continued to feel that the weight, as well as the length of string, had something to do with the length of the period. C5 also was not able to separate the length of string from the weight of the pendulum. C6 told me he already knew the only variable was the length of the string because he had done it in Physics. He knew the way to test whether the weight affected the period or not was to experiment with different weights and different lengths of string. He compared it to a weight on a record player. He said a weight close to the center would move slower than a weight on the outside of the

record. This I disagreed with and was wrong. He said, "Okay, look Liz. Right here, if I moved this part of my finger (the bottom) an inch, this part of my finger (the tip) would move like an inch and a half. . . (because it's going further) it has to be going faster too."

The proportional reasoning task used a balance scale with numbered pegs and ten to fifty gram weights. A ten gram weight was put on a numbered position on one side of the scale. The child was then asked where s/he could put the twenty gram weight in order to balance the scale. I did this task with the four oldest children. C3 basically guessed at where to put the weights in order to get the scale to balance. C4's strategy was to first put twenty grams on eight because I had ten grams on four. He then used the number of pegs I moved my weight to decide where to put his weight. C5 based her decisions on the fact that the scale, ". . . is like a teeter totter. The little one has to be further away to balance it." She also first made her decisions on where to move her weight based on how many pegs I moved my weight. This did not work. She ended up moving her weight based on the reasoning that, ". . . twice as much weight would have to be half as much leverage." C6 felt that, ". . . the closer in, the less weight you need." He figured out fairly quickly that double the weight needs half the numbered peg.

In conservation of volume I used ninety one-inch wooden blocks. I showed the child a building four blocks high with a base of three blocks by three blocks. I told the child that each block was a room. I then asked the child to build a building that would have the same number of rooms as mine, but with a base of two by three blocks and then a base of two by two blocks. After each building

was completed, I asked the child how s/he knew her/his building had the same number of blocks as mine. I did this with all of the children. C1 simply added layers without getting the same number of rooms. C2 tried and said he couldn't do it. He felt the shorter building had fewer rooms, "Because that one's fatter." C3 made a building with three extra rooms. When she tried to make her building look like mine she realized she had too many rooms. She then made her two by three building correctly. C5 had no problem at all either making the buildings or justifying what she had done. After making her two by three building she showed me how she could make it a three by three building by taking the two top layers off the top and putting it on the side of the building.

In probability I used ninety-six wooden blocks of four different colors: thirty-six red, thirty-six blue, twenty green and four yellow. I put one-half of each color in a paper bag and gave the other half of each color to the child to use as a reference. I took out two blocks at a time, without looking at them, first asking the child what colors s/he thought the blocks would be. Periodically I could ask the child "Why?" after the predication and before the draw. I did this with the four oldest children. C3 couldn't give me a reason for her predictions and at one point simply started predicting whatever came out of the bag last. C4 and C5 put their blocks in front of them and as I took blocks out of the bag moved those blocks out of their pile. She started predicting red and blue, "'Cause there's the most red and blue." She then based her predictions on what colors she had left in her pile. At the end she said, "That was

annoying." C6 also based his predictions on the number of colors in his pile, although he wasn't as methodical about it as C5.

In addition to doing Piagetian tasks with children using the clinical method, I also incorporated his clinical method into the work I did with my science groups. The way in which I did this was to begin asking my students questions about why they thought a particular physical phenomenon was happening. This is different from asking why something is happening expecting a "right" answer. From my point of view whatever they answered was right because I was asking what they thought. At the beginning they had trouble with this as they didn't want to answer unless they thought they knew the "right" answer. I had to assure them that whatever they answered was right because what I wanted was their thoughts about what was happening.

These groups loved working with dry ice. One of the activities was to use the vapor from the dry ice to pour over a candle flame to see what would happen. One of the first questions I asked them was why they thought the dry ice put out the candle flame. I got a variety of answers. Some of them were: "Because there's the cold air that comes out of the smoke and whenever it touches the candle the cold wind hits the fire and it just put it out, kind of like cold water" (15 yrs., 3 mons.); "Because the candle uses the oxygen as fuel and the carbon dioxide smothers the oxygen" (age 13 yrs., 9 mons.); ". . . because carbon dioxide takes oxygen away and the flame needs oxygen to burn" (10 yrs., 10 mons.); "I think because the dry ice is putting out really cold smoke or whatever that is and it's putting out the fire because of the temperature" (age 9 yrs., 10 mons.); "Because

it's not oxygen. I've got an idea! Because this (the carbon dioxide) is almost like air and air blows out fire" (age 9 yrs., 9 mons.); and "The steam blowed it out" (age 4 yrs.). The three main ideas that came from this question were that the movement of the carbon dioxide vapor blew out the candle, that the coldness of the vapor put out the candle, and that the candle needed oxygen to burn and the carbon dioxide kept the flame from getting oxygen.

Three other questions I asked had to do with bubbles, another material students love working with. One question I asked about bubbles was, "Why do you think bubbles pop?" Some of the answers were: "I think it's because after a while the air inside them, the stuff won't keep it anymore, and so it has to pop because the stuff won't hold its shape right" (8 yrs.); "Because stuff on the top pulls down to the bottom and they pop; the chemical solution that's on the top of the bubble; weight and gravity, it just comes down" (9 yrs., 7 mons.); "They're too thin to stay together" (10 yrs., 4 mons.); "It pops because the air blows on it" (11 yrs., 2 mons.); "Because air hits them and makes them pop because air is dry" (12 yrs., 6 months); "They lose all their water and soap to stay together and when that happens they pop. They lose it by using it up to their structure" (14 yrs., 10 mons.); and "Because if you look at them closely you can see stuff dripping off the bottom of them, so I think all of the chemicals holding it together dripped off the bottom and it goes pop!" (13 yrs.). Another student adds, "Yeah, that's also because of gravity" (14 yrs., 2 mons.). The first student says, "Yeah, right gravity."

A second bubble question was, "What do you think causes the colors in the bubbles?" This was in conjunction with an activity in

which they were asked to noticed how the colors in the bubble changed until it popped. Some of the answers to this question were: "I think that because of the sun that has all different colors it'll make different colors on the bubble" (8 yrs., 10 mons.); "The light refracting off of the soap" (9 yrs., 7 mons.); "The light, the reflection, the reflection of the light with the soap" (11 yrs., 5 mons.); "I think light shining through it and reflecting off from the inside" (12 yrs., 2 mons.); "The reflection of the light" (13 yrs., 9 mons.); and "The chemicals in the soap" (13 yrs., 7 mons.).

A last question about bubbles was, "Why do you think bubbles always form into spheres instead of forming into cubes or other shapes?" Some of the answers were: "That's just their normal shape because a bubble couldn't make corners" (8 yrs., 10 mons.); "Because all the, it'd be hard for the air pressure to stay in a cube. It'd be impossible to get the same pressure everywhere; no, that wouldn't be right; anyhow it's just easier for all the sides to go out as far as they could instead of the planes on the square cannot go out as far" (9 yrs., 7 mons.); "I think why they're usually round or oval or some sphere is because it's easier to keep than a flat thing" (10 yrs., 2 mons.); "The soap, like when you blow into whatever you're blowing into, it has like circular holes, and it would be too hard to make something that you'd blow out of to make a triangle" (11 yrs., 7 mons.); "Because it's easier; because a square, it's harder to get out the corners" (12 yrs., 6 mons.); "It holds itself together because it's all pushing the same on all the sides" (13 yrs.); and "The pressure around the outside of the bubble is higher; the pressure inside the

bubble is really low so the pressure on the outside of the bubble is pushing it together into a sphere" (age 14 yrs., 2 mons.).

One of the discussions I taped and transcribed was about why some materials float and some materials sink. The group had been working with spheres about one inch in diameter made of different materials and two different sizes of cubes made of different materials, about one inch square and one centimeter square. Some of the students thought that some of the materials that floated had air bubbles in them. We weighed two small cubes made of different materials. Both weighed two grams. One sank and one floated. One student thought it had something to do with "the skin of the water." There was a discussion about whether water has a skin. There was then discussion about the effect of weight on whether objects sink or float and discussion of why something with air in it floats and whether it always floats. One child made a clay ball with air in it and it sank. C says, "You had more of the clay than the air." W says, "I made a really teeny, tiny one that was really, really thin." S made a clay boat that floated because she says, ". . . the shape, the water just kind of carried it 'cause of the shape pushes up and carries it around." A says, "Because there's air inside of it, that's why." They then went back to discussing why the white plastic cube floats and the clear plastic cube sinks. A says, "It's the material." S says, "Something about the material makes it float." They continued to play with the idea that whether objects float or sink has something to do with the materials they're made of. When working with children in science it's important to remember that the goal is not necessarily to teach the "right" answer. Although the group did not

come up with the "right" answer, this discussion gave them good groundwork for thinking about the phenomena of floating and sinking. In subsequent dealings with these phenomenon they will have the background of having already discussed theories from which to continuine working.

I will go on in the next chapter to discuss my findings and interpretations about the Piagetian tasks, questions, and discussion.

CHAPTER 5

FINDINGS AND INTERPRETATIONS

In this chapter I will describe and explain my findings in doing my research both with the Piagetian tasks and in incorporating Piaget's clinical method and what I have learned about children's reasoning into my science teaching. I have learned many aspects of the way in which children think and reason in doing these interviews. What I learned in doing Piagetian tasks with children was: how to prepare for and do a clinical interview; what to pay attention to when doing an interview; how children's reasoning determines what developmental stage they are in and along with this surprise at some of the classical reasoning the children gave; to confirm that the stages are not age specific; and how to incorporate the clinical method into my work with my science groups. Most importantly, I learned much more about how children construct their own knowledge and how this relates to their need to learn experientially.

First I will discuss what I found about Piagetian stages and development in children. As I explained previously, I taped each interview of the children doing Piagetian tasks and transcribed the interviews using a word processor. I found the process of transcribing the interviews really interesting and helpful for several reasons. One was that when I listened to the tape and typed it out, I noticed more about what was going on with the child's reasoning

processes than when I was actually doing the interview. This helped me listen to the child better the next time I worked with her/him. Another reason this was so interesting was that, in the process of transcribing, I learned a lot about the mistakes I made in the interview process itself. For instance, the first time I did the interviews, when a child gave the "right" answer, I asked for her/his reasoning, but didn't ask for her/his reasoning when s/he gave a "wrong" answer. When I sat down at the computer to transcribe the first tapes I realized immediately what I had done, so that in later interviews I asked for reasoning regardless of the answers. I would also notice areas where I needed to extend the interview to clarify for myself what the child was thinking. Another mistake I made, especially at the end of this last semester, was in not immediately transcribing the tapes. When I didn't do this within a week of doing the tasks, I would forget some of what went on with the child.

In doing these interviews with the children I was surprised at the classical reasoning that was given by the children. Even though I had read interviews of Piagetian tasks being done with children, I was still surprised at how the children I worked with gave, in some cases, almost identical reasoning to what I had read. When asked why they thought the snake-shaped piece of clay was or was not the same amount the reasoning ranged from, because there was no clay added or taken away to because it's skinnier or longer. These are standard reasonings that concrete operational and preoperational children give. I also didn't really believe, until I heard it myself, that a five-year old child would think the snake-shaped clay had more clay in it because it was longer.

In working with the two youngest children I had a surprise. C2, whom I did the first tasks with, was classically preoperational. This was where he was "supposed" to be for his age. C1 was classically concrete operational in most of the tasks. This is not where she was "supposed" to be. She is younger than C2 and should also have been preoperational. The other surprise with her was that she not only knew the "right" answer in doing the tasks, she was also able to clearly verbalize the reasoning behind her answers. Some of the reasoning she gave was: "You didn't put anything on to it. You just moved it higher"; "Because all of the beads are wooden"; and "'Cause when you go one in the cup, one in the bag, and when the last one in there (the bag) is the last one, it means that it's even." These answers are similar to the ones C3, who is three years older, gave. Children 3, 4, 5, and 6 were all able to give the "right" answers and reasoning for these tasks. This was not a surprise because of their ages. They, in fact, all looked at me a little strangely when I asked them, in the conservation tasks, if there was still the same amount of material and why. C4 was a surprise in that he was, in several areas, as articulate as the two older children were in describing his reasoning and was formal operational in one of the tasks. Older students, though, were generally better able to verbalize their reasoning than were younger students.

In doing these tasks with the children I was able to get a clear picture of Piaget's stages of development. I was able to clearly observe children's responses and reasoning in the preoperational, concrete operational, and formal operational stages. I was able to observe that some children were preoperational in some tasks and

concrete operational in other tasks, or were concrete operational in some tasks and formal operational in other tasks. At the beginning of the year C1 was concrete operational in seven tasks and preoperational in three tasks. C2 was concrete operational in one task and preoperational in nine tasks. C3 was concrete operational in all ten concrete operational tasks. C4 was concrete operational in all ten tasks and formal operational in one of the five formal operational tasks. C5 was concrete operational in the ten concrete operational tasks and formal operational in two of the five formal operational tasks. C6 was concrete operational in the ten tasks and formal operational in three tasks. This information about each child indicates to me that the stage at which a child is in depends as much on the individual child as on their age. Piaget emphasized that although the ages at which children are in particular stages may vary, that it is the order in which the stages occur that do not vary.

I was able to observe the centering and decentering process while doing these tasks with the children. In the conservation tasks, C1 centered on the differences in appearance of the materials. C2 centered on the difference in appearance in the conservation of substance task, although was puzzled by it. She started to center on the difference in the conservation of liquid and then decentered and noticed other aspects of the liquid that conflicted with her original impression. The other aspects were that although the liquid gained in height that gain was balanced by being in a smaller diameter container. She did not articulate her reasoning in this way, but knew it was the same amount of water. I was also able to observe the reversibility that accompanies decentering. The children who were

able to decenter were showing reversibility in their thinking. The were able to mentally reverse what they were observing. They knew that the snake-shaped clay was the same as the ball-shaped clay because they could picture it as a ball in their minds. C4 stated, in the conservation of length task, that he knew the rods were the still the same length, "Because I can just kind of somewhat picture them in my head together."

I discovered many new ideas about how children learn experientially in using the clinical method in working with children both in the individual task setting and in my science groups. Using this method really helped me to focus on what children were thinking about what they were doing and what their processes were in trying to figure out the problems they were given. Working with children in this way substantiated what I had read by Piaget, Eleanor Duckworth, David Hawkins, David Elkind, Howard Gardner, and Constance Kamii about the way in which children incorporate new ideas into their learning, the way they construct their own knowledge. Just giving children information about physical phenomena cannot begin to help them really understand those phenomena. This is because of the preexisting knowledge on which they base their ideas. I had not really noticed before this time the extent to which children have their own theories about the way the world works. I just assumed that they simply didn't know why something worked the way it did or that their ideas were "wrong" and something to be corrected. I realize now, that regardless of the question, children almost always have their own answer. They rarely say they don't know the why of something if given the

opportunity to explain in a non-judgmental situation. I also realize that their "wrong" answers cannot merely be corrected with information. Children must be given the opportunity to explore, using appropriate materials, in order to discover for themselves the answers to the "why" of physical phenomena. They, in fact, must be able to use their own theories and reasoning in figuring out physical phenomena. This is the basis of constructivism.

I used what I learned about the way children reason to change the way I work with children in my science groups. I now set up the work with students so that the focus is on reasoning, rather than on answers. What I did with the clinical method in my science groups was to try to incorporate the same type of question-asking I used when doing the Piagetian tasks with individual children. I started emphasizing open-ended questions that did not have right answers, assuring students that all answers were acceptable; that I wanted to know what <u>they</u> <u>thought</u> about why something was happening. This had two effects. One was to help me better understand the thinking and reasoning of the students. This type of questioning helped me to focus on what the child was really thinking about a particular phenomena. This in turn helped me to provide the child with the materials and opportunities s/he needed to continue with their explorations. The second effect was it told the children that I respected their reasoning. The students felt more comfortable and competent in continuing to work with the materials. They knew they were not going to be "wrong" and that their answers were simply information to help them continue their investigations.

I found that children do have their own ideas and theories about why a particular physical phenomenon is occuring. Having a theory is the basis for continuing with an exploration of the phenomenon. When a child does not have a theory for what is happening s/he has no interest in or investment in continuing the investigation. Karmiloff-Smith and Inhelder discuss this in the article "If you want to get ahead, get a theory." They point out in this article that in order to figure out a particular problem, a child must already have in her/his head a theory about that problem. S/he must already have an idea about why the phenomenon is happening the way it is in order to then test her/his idea and continue with the exploration of it.

Formerly I would have told students, after getting the "wrong" answer, what the "correct" answer was. I would have assumed that giving them the right answer would change their thinking. I have changed the way I work with students in that I now give them the opportunity to continue to have experiences with the materials until they find out for themselves, while working with other students, their own answers to their own questions. What I found was answers that I would have previously, and at face-value, looked at as "wrong" were actually answers that were on the right track. Looking at their answers in this way also helped me understand how the child was thinking. This in turn helped me understand how to give the students more experiences that would help them clarify their thinking.

I found the answers and reasoning the students gave me extremely interesting and it has made my work with them more

interesting than it already was. With the question, "Why do you think the carbon dioxide put out the candle?", the older students generally felt it was the lack of oxygen that kept the flame from burning and the younger students felt either the coldness or the vapor blowing on the flame put out the candle. Although the students who felt the coldness or blowing of the vapor were "wrong," it is important that they had a theory and were interested in investigating why the candle was going out.

With the question, "Why do you think bubbles pop?", students felt it had to do with air pressure, air hitting the bubble, the bubble getting thinner, and the soap weakening. Three students noticed that the solution at the top of the bubble is pulled down by gravity until the bubble loses so much solution at the top that it pops. Continuing to give these students opportunities to work with the materials and with each other would help all of them discover why bubbles pop. With the question, "What do you think causes the colors in bubbles?", student responses included the bubble formula, the sun, the solution itself, and the chemicals in the soap. Almost half of the students felt it had something to do with the sun or light hitting the bubble; they knew that sunlight was made up of a spectrum of colors. They were then using this knowledge they already had to incorporate it into a new problem solving situation.

The question, "Why do you think bubbles form into spheres instead of forming into cubes or other shapes?" caused much pondering and thinking. They seemed to have a tougher time trying to figure this one out and formulate a theory for it. Most of the students, regardless of their age, felt that a sphere is the easiest form

for the bubble to take; this is something they intuitively felt or "knew." Although this was a tougher question, I was surprised at how most of the students were on the right track with their answers and reasoning. What I found really interesting about the students answers to the questions is how hard many of them worked at trying to figure out their own confusion and how they weren't intimidated by trying to do just that.

When teaching in this way, I had to realize that not all questions were going to be answered for every student because we were, as Duckworth puts it, "learning with breadth and depth" rather than learning with speed. We were not concerned with the quick right answer, but with following our ideas as far as they would go. What this means is that these students will probably continue to follow-up on some of their ideas in the next school year. I have already been told by students that they want to continue with dry ice activities next year. This we will do.

In addition to the Piagetian tasks and incorporating the clinical method into my science teaching, I also asked my chemistry students to write a short paper about what they felt they learned this year and what they liked and didn't like. The responses about what they liked and didn't like were most interesting. For the most part they liked the activities that were not as structured and where they were able to explore aspects of the phenomena that interested them most. They didn't like the more directed activities where they were answering the questions I gave them rather than answering their own questions and following their own paths of exploration. One of the least favorite activities was testing liquids for vitamin C. In this

activity the main question was, "Which liquids have the most and which have the least amount of vitamin C?" There was not as much room for the development of other questions as there was in the bubble and dry ice experiments. The more dramatic the experiments were, and the more room there was for many questions and routes of exploration, the more the students became really involved in and focused on an activity. Some of the comments from the students about this were: "I also liked when we were working with dry ice, because we could do whatever we wanted with it"; "My favorite class was when we were working with dry ice. I liked it because we could do anything we wanted to"; "I like doing chemistry because it's like you're finding out all these cool things and you really are"; and "The thing that I liked the most were the bubbles, because I could make them with a lot of things."

Other comments from students included: "I didn't like cleaning up, but I know you have to"; "The talks helped find out what other people wrote and thought"; "The thing I hated the most is having discussions about the stuff that we have been doing, because it was boring"; "The things I didn't like about chemistry is cleaning up everything when we're done with the projects. I also don't like writing everything in my book about everything we did"; and "I also learned that you can get burned with dry ice and to listen to your partner." All students in all of my science groups kept journals on what they did. Most of the students really enjoyed writing in their journals. I only got the one comment expressing dissatisfaction with writing and only two who didn't like the discussions. I found that bubbles and dry ice were by far the most popular activities, with

floating and sinking and the vitamin C testing being the least favorite.

Another change for me was in the way I now think about group work. My students have always worked together on science activities. I am now much more aware of the importance of group work and how group work helps children to construct their own knowledge. When children try to explain their reasoning to each other they often correct themselves. In the process of explaining their reasoning to someone else they must decenter. They have to coordinate their points of view with others and in doing so may recognize their own mistakes (Kamii 1984, 413). I saw this happening continually. They were always interested in what everyone in the group was doing and trying to explain to each other why they were reasoning in the way they were. When one child or group disagreed with the reasoning of another child or group there was much discussion about what might really be happening. My job in this was to be aware of their reasoning, not for the purpose of pointing them toward the "right" answer, but to help them continue to clarify their own reasoning and to continue to give them the materials and experiences they needed to do so.

I really enjoyed this whole process. It was fascinating to watch children as they did the tasks and then give their reasons for doing them as they did. Watching children do these tasks, for the purpose of discovering why they reason as they do, is totally different from testing children to find out if they "know" the right answer. I have never believed in testing anyway, but I have found even more

reasons to justify why testing does not show what children really know, only the content they may not know.

I have noticed that when I now listen to children, regardless of the setting, that I listen to them differently than I did before. I am starting to really listen to what they are saying and what the reasoning might be behind what they are saying. I do not now assume that their answers are "wrong" or that their reasoning is "wrong," but that they have a legitimate basis for answering and reasoning the way they do. I am consciously listening to children differently when teaching my science classes, but I also realized I am listening differently anytime I listen to children talking and interacting. This master's project has opened up a whole new world for me that I have enjoyed immensely and will continue with. I have always loved my job as a teacher but was in somewhat of a rut, although I didn't realize it. I went to science conferences and was involved in finding out as much as I could about new activities to do with students. What I was lacking was why it is so important, from a Piagetian standpoint, for children to be involved in activity-based learning. I now have a whole new perspective from which to continue my growth as a teacher and a learner.

I have found many new avenues and questions I want to continue to explore in doing this study. One is I feel that the Kino students I am working with are remarkably perceptive in their observations about what they see happening, possibly more so than children working in a traditional setting. I think this may be because of the experiential background in all content areas that they have had here at Kino. I have noticed that the students that have been at

Kino the longest were more willing to try new ideas in the use of the materials and more willing to talk freely about their ideas. The newer Kino students were more hesitant to try new ideas to begin with and were more worried about whether they were doing it "right" and had the "right" answers. By the end of the year though, these students had relaxed, were very willing to explore the materials, and were not worried about "right" answers. Another new avenue is an interest in teacher research and how I, as a teacher, can research learning in my work with children. This is something I will continue to research and explore.

Gaining an understanding of how children and adults construct their own knowledge, based on what theories they already have, has lead me to a better understanding of how two people receiving the same information, can come up with two completely different interpretations of that information. It makes me think that people who believe in the behaviorist's model have never experienced the joy of intrinsic motivation. They don't know what it's like to feel truly passionate about something from the inside.

Doing the Piagetian tasks with students helped me understand in a very real and concrete way how children learn experientially by constructing their own knowledge. With this research I was able to incorporate the theory I learned from the literature and apply it. I saw for myself how children construct their own knowledge, how they do this based on the theories they already have in their heads about the way the world works, and how they must have concrete experiences with the materials in order to do this.

CHAPTER 6

DEVELOPING AN EXPERIENTIAL SCIENCE CURRICULUM

In this chapter I will discuss the importance of using the constructivist paradigm in developing experiential science curriculum. Constructivism must be taken into account when developing an experiential science curriculum because it explains how children learn. This paradigm is particularly relevent to science education because the operations Piaget identified are ways of thinking which underlie much of scientific thinking--classification, ordering, and use of hypothetico-deductive thought. The majority of the tasks Piaget developed were for the purpose of understanding the reasoning of children involved in the manipulation of physical objects and to give information about how children develop their understanding of the physical world (Hodgson and Scanlon 1985, 99).

There are several basic ideas about how children learn that need to be taken into consideration when developing experiential science curricula. These are that: children learn by doing and constructing their own knowledge; that constructing knowledge requires collaboration; that children's behavior and thinking develop over time; that children are individuals; that children are continually revising their understanding of the world; and that feelings are a part of learning (Doris 1991, 14). All of these ideas are related to

Piagetian theory and will be addressed to one degree or another in this chapter.

One of the most important findings as I researched this chapter was that, although there is much agreement among educators about the importance of taking Piagetian theory into consideration when developing science curricula, there is much disagreement about the interpretation of Piagetian theory and the amount of structure needed in a science program. The differences seem to lie in the belief of which is more important--process or content. Educators who feel process is important, but their emphasis is still on content, are more structured and controlling. Educators who feel that content is important, but their emphasis is on process, are less structured and controlling. My beliefs lie with the latter. I feel that the emphasis should be on process and that the content will be learned through the process. I believe that when content is learned in this way, there will be genuine understanding. I feel, in fact, that when the emphasis is on content, this gets in the way of process, and that only through process can there be real understanding of the phenomena being studied. Learning through process, rather than content, is important when looking at learning from a constructivist viewpoint. It is only through process learning that children can construct their own knowledge. Piagetian theory emphasizes process in science education:

> . . . the repetition of past experiments is still a long way from being the best way of exciting the spirit of invention, and even of training students in the necessity for checking or verification. . . if the aim of intellectual training is to form the intelligence rather than to stock the memory and to produce intellectual explorers rather than mere erudition, then

> traditional education is manifestly guilty of a grave deficiency (Piaget 1977, 51).

Process oriented education is built upon the idea that children construct their own knowledge from previous knowledge through their interactions with the environment. John Staver, along with other educators and psychologists, feels that the focus on Piagetian stages and the attempt to move children into formal operational reasoning as quickly as possible is a misrepresentation of Piaget's theory. Constance Kamii, a researcher who worked with Piaget, feels the true epistemology behind Piaget's theory lies in the ideas of constructivism, the nature of human knowledge, and learner autonomy (Staver 1986, 4).

In order to understand constructivism as an epistemological model, Staver reviews a major debate in the history of epistemology. The question he explores is, "In what realm does the structure of knowledge lie?" He feels that rationalist, empiricist, romanticist, and constructivist epistemologies each addressed this question. Rationalists believed that truth was the result of logical deductions and existed in the external world. These deductions were based on mathematical models (Staver 1986, 6). Empiricists also believed that truth exists in the external world, but used inductive reasoning from evidence based on experience. They believed that reality was perceived through the senses, and their basis for truth was verified by experience. They rejected the rationalist's idea that the existence of an idea in one's own mind proved its existence (Staver 1986, 7).

David Hume was critical of both rationalism and empiricism. Unlike empiricists, he felt that experience alone could not account for

all aspects of knowledge. He felt knowledge was based on causality, the permanence of objects, and the constancy of self. He felt these were subjective inputs from the mind that were integrated with experience and because of this were not aspects of external reality. He was also critical of rationalism in that he felt that although mathematical statements may be true, they do not necessarily give knowledge of the real world. Epistemologists who accepted the rationalist and empiricist ideas had to prove how knowledge was based externally. As they were unable to do this, it suggested that the external objective realm did not contain the structural elements of knowledge (Staver 1986, 10).

Romanticists, through Rousseau, believed that knowledge was based internally. They also believed that a person's natural feelings coincided with the structure of external reality. The challenge to this belief was that internal feelings do not prove external existence (Staver 1986, 10). In other words, because a person has a feeling about something does not prove its existence. Immanuel Kant attempted to address this problem to show how the "structural elements of knowledge could be shared by the external and internal dimensions of reality." Kant invented a third layer of reality in which the mind is an active agent that organizes and coordinates experiences. He felt that in this third layer lies the structural elements of knowledge. Their function is to interact with the internal and external dimensions (Staver 1986, 12).

Kant's views are very similar to Piaget's ideas of the construction of knowledge. Both felt that the concept of object is located in the structures of the mind. Reality is the phenomena we

experience through construction. Where they differ is that Kant's categories of space, time, and causality were based on what he felt was already existing, permanent knowledge. Piaget's intellectual operations are based on the changing of known knowledge, over time, through his equilibration mechanism (Staver 1986, 15).

Staver feels that when science educators focus on the Piagetian stages, rather than children's reasoning, they ignore the importance of constructivism, the nature of knowledge, and learner autonomy. What they do is apply Piagetian theory from an empiricist standpoint (Staver 1986, 17). Constance Kamii compares the construction of knowledge as the interrelated whole of a growing embryo rather than as a collection of pieces added from the outside (Kamii 1982, 2). She points out that as leaves can only be grown by a plant from within, that knowledge can only be constructed by the child from within. She states that, "Traditional education is like trying to grow trees by pasting leaves from the outside" (Kamii 1982, 4).

In the traditional teaching of science there is the belief that prior to being taught, children's minds are empty, waiting to be filled by a teacher. This is an empiricist belief. Because of this belief, science is taught through content. Questions then come up among educators of how and why content is later lost. Various explanations include that the teaching was inadequate, the students were inattentive or lacking in scientific intelligence, or that the ideas were too difficult. These are not the problems at all. The problem is that the way children learn is not taken into consideration in traditional science curricula. Research has shown that children's minds are not empty at all--they are full and must in some way be enlarged

(Duckworth & others 1990, 105). This means allowing the child to build on the knowledge s/he already has through assimilation, accommodation, and equilibration. Children must be allowed to construct their own knowledge, through experiential activities, in order to truly learn.

The traditional view of science curricula is also based on the assumption that learning can be made efficient. It stresses structured, prepared materials with clearly stated learning goals and specific objectives. "Objective" tests are then used to measure the achievement of the goals and objectives. Contrary to what some educators would like to believe, learning is not an efficient process. It is messy, unpredictable, and takes time. Students must make sense of materials and phenomena through extended exploration, experimentation, and discussion (Duckworth & others 1990, 9). Science curricula, rather than being structured and prepared by the teacher, should allow for a situation where students can work with materials that interest them and allow for a wide variety of exploration. The teacher's role should be to select engaging materials, arouse curiosity, maintain a supportive climate, and to ask questions that extend thinking (Duckworth & others 190,12). I feel the two most important of these, on the part of the teacher, are to maintain a supportive climate and ask questions that extend thinking. If the teacher follows the interests of the child, the curiosity will already be there and the child's interests will help to determine the selection of materials. The overall purpose of a science curriculum should be to engage students in investigations, not to urge them through activities they are not interested in

(Duckworth & others 1990, 25). Curriculum implies an organized attempt to teach something, yet learning does not happen in an organized way, except that which is organized in each individual's mind. I feel the answer is to not have a predetermined content, but to base the curriculum on the interests of the child. This is basically what we do at Kino. The goal at Kino is not to move through a predetermined curriculum. The goal is to engage students in learning activities through their own interests. Children are already excited about learning. The goal is to keep them excited.

An evaluation study was done by Eleanor Duckworth from 1965 to 1967 to compare students in an experiential science program with students who were in traditional programs (Duckworth 1978, 34). This program was the African Primary Science Study, which Duckworth helped develop. The purpose of the program was to help children become familiar with the material world--biological, physical, and technological phenomena. Simple, easy to find materials such as flashlights, mosquito larvae, clouds, and clay were used (Duckworth 1987, 8). Duckworth had been told by teachers of the experiential program that they felt their students had improved in thinking of new ideas of what to do with materials, at raising their own questions, and at answering the questions they had raised. Duckworth wanted to confirm these findings. She also wanted to find out if these students had made significant gains in their intellectual development. Fifteen experiential classes and thirteen control classes from first to seventh grades were studied. Students from the experiential program had been in the program a year or more. All of the students in the study were given materials to work with, but no

problem to solve. It was up to each student to find a problem and then work on it. This study was to assess two things: diversity of ideas and the depth to which ideas were pursued. Duckworth found that the children in the experiential classes had more ideas and worked longer on their ideas than the students from the control classes. Overwhelmingly there was greater intellectual alertness in children who had been in the experiential program. Duckworth's hypothesis is that it is this alertness which is the motor of intellectual development. Some children are much more alert than others and when we open up to children the many fascinating aspects of the world, when we help them to feel that their ideas are worthwhile, we enable this alertness (Duckworth 1987, 12).

A second aspect of the African Primary Science Study was to examine the same children individually, using Piagetian tasks. It was found that the children in the experiential program did significantly better than the control children on five of the six tasks studied. It is important though to stress that the goal was not the acceleration of Piagetian stages or to stimulate intellectual ability. The goal was to allow children the freedom to be intellectually creative, the happy result being that they not only learned about the world, but general intellectual ability was stimulated as well (Duckworth and others 1990, 12). I think that when an educator's goal is to accelerate stages or intellectual ability, that is when s/he becomes too controlling. At that point, the desire to be in control and in charge gets in the way of the child's intellectual growth. The goal becomes the adult's goal, rather than the child's goal and intellectual creativity and learning is stopped.

Since we know that what is already in the learner's mind will affect further learning, we can use the constructivist paradigm to build on this by paying attention to the prior knowledge students bring to each learning experience. Learning is promoted by both hands-on and minds-on instructional techniques (Loucks-Horsley & others 1990, 47). Minds-on has to do with the activity that is going on in the child's mind when s/he is working with concrete materials or, as in formal operations, thinking about her/his thinking. I would like to clarify here the meaning of the word "activity" when children are working with concrete materials. The knowledge that a child constructs from working with the materials comes from the mental activity involved, not directly from the objects or their manipulation (Duckworth & others 1990, 143). Work with concrete materials is important not because manipulation of the materials is the goal. The particular materials worked with are not the main factor in the construction of knowledge. If it were, the same materials manipulated by different children would yield the same results in terms of the knowledge acquired. What is important is the activity going on in the mind of the child when working with the materials. This can be inferred from the activity that is going on with the object (Duckworth & others 1990, 10). When children are given materials and fully allowed to explore those materials, they are then able to construct their own knowledge based on the knowledge they already have in their minds. This is very different from simply following a teacher's directions in order to move through a science activity and arrive at a preconceived answer. When children just go through the motions of following directions, they are not able to construct their

own knowledge and quickly forget the answers they arrive at because they are not their own. They have no ownership in the results.

Using the constructivist paradigm we have to rethink our assumptions about learning and instruction. Learning is not a passive activity. For learning to really be happening there has to be both hands-on and minds-on activity. Instruction is not something teachers do to or for students. Individuals must set their own goals and control their own learning. The final responsibility is with the learner, not the teacher (Loucks-Horsley and others 1990, 50). This is a part of our philosophy at Kino, although I don't really look at learning as a responsibility as such, particularly with younger students. I feel learning is a natural part of the growth of a child. The responsibility of the teacher is to provide a nurturing environment that can meet the needs of all interests and learning styles. The authors here state that the teacher becomes a diagnostician and prescriber of appropriate learning activities and is a facilitator of learning (Loucks-Horsley and others 1990, 50). I agree that the teacher should be a facilitator, but I don't like the use of the words diagnostician and prescriber in describing teachers' roles because they feel too authoritarian. I feel that it is important that the learners be very much involved in the decision about what are appropriate learning activities for themselves, with the teacher facilitating the activities. Again, we come to the problem of choice, who makes what choice for whom, and who will be in control of the learning. I believe that if it is the teacher, then the child cannot construct her/his own knowledge and therefore cannot really learn.

Children, to understand the world, organize, interpret, and explain it to themselves. From this process comes a body of ideas, beliefs, and theories one could call child physics or biology. There has been much research done and discussion about children's own theories. These spontaneous ideas of children are authentic productions of child thought, are resistant to modifications from outside, and evolve through equilibration. Counter examples, contradictions, and situations that give rise to cognitive conflict play an important role in the development and modification of the child's own theories (Duckworth & others 1990, 149).

Barbel Inhelder was a colleague of Piaget's who worked with him for many years. She was involved in many studies of children and the way they reason. Two themes came out of the studies done by Inhelder. The first is the presence of constant activity on the part of the child between trying to achieve a certain result and trying to understand the situation. It is only when a child has a theory to begin with that s/he can pay attention to results that contradict that theory and try to figure out some other theory that would take them into account. Both scientists and children improve on their theories by looking for exceptions (Duckworth and other 1990, 87). The second theme is that knowledge has three lines of access. The first is perceptual--something about the look of things connects with the way things have looked in the past. The second is action--what we are doing connects something we have done in the past. The last is conceptual--an idea or a word links to something in the past (Duckworth 1987, 45). When teaching children we must take into

consideration their own theories in order for them to be able to accept new theories and fit them into their own frames of reference.

Psychologists consider children's theories to be authentic constructs; too many educators consider them to be obstacles in the way of learning (Duckworth and others 1990, 149). These educators feel that children's existing beliefs about how the world works are so idiosyncratic and confused that the best thing to do is to ignore them, and to teach scientifically accepted beliefs carefully and well (Duckworth & others 1990, 10). Ignoring children's theories does not work. According to Piagetian theory, children assimilate new knowledge according to their existing beliefs. With this in mind, it is important to take children's own belief systems into account when teaching science. Children may be taught scientific concepts, carefully and well and may do well on tests, but many times they do not carry this knowledge to new situations and, in fact, have not given up their own beliefs. What is most important is allowing students the opportunity to articulate and think about their beliefs rather than trying to eliminate wrong beliefs (Duckworth & others, 11). If students are not given the opportunity to express their own ideas and feel comfortable about doing so, they may not be aware that a conflict exists between their own theories and scientifically accepted theories. Science teaching that expects students to be passive simply pours information on pre-existing ideas. If the information doesn't "fit," the students will hold on to the pre-existing idea. S/he will retain the new information only long enough to pass the test. When the students can test ideas for themselves they will

add to or extend the existing concepts, or radically reorganize their conceptual framework (Loucks-Horsley & others 1990, 49).

There are two aspects to teaching from a constructivist standpoint: the first is to put students into contact with real hands-on phenomena related to the area to be studied and help them notice what is interesting about it; the second is to have students explain the sense they are making of the phenomena, rather than the teacher explaining the phenomena to the students (Duckworth 1987, 123). When students explain what they think and why they think it: 1) learning is involved in explaining; in trying to make their thoughts more clear to others they also become more clear to themselves; 2) when students make the decisions about what it is they want to understand, the questions, as well as the explanations, come from them; 3) students come to depend on themselves--they know why they believe what they do, what questions they have about it, their degree of uncertainty about it, what they want to know next, and how it relates to what other people think; other "explanations" must establish their place with what the students already know; 4) students realize the powerful experience of having their ideas taken seriously; 5) students learn from each other; 6) they come to realize knowledge is a human construction since they themselves have gone through the process of constructing their own knowledge and are aware that they have (Duckworth 1987, 130). Another important point is the feeling of self-worth children get from going through this process.

Along with the opportunity to express their own ideas in science, children need to be allowed to answer their own questions.

Duckworth discusses what she describes as "the having of wonderful ideas." She feels that the having of wonderful ideas is the essence of intellectual development (Ayers 1993, 58; Duckworth 1987, 1; Jervis and Montag 1991, 15). Alertness in children is fueled by knowing they are capable of wonderful ideas. By wonderful ideas she means ideas that students come to all on their own--the ideas they come up with in constructing their own knowledge. Wonderful ideas can be ideas that have already been discovered by others, but are new to the person who is just now discovering them. These ideas usually happen to children when they are in a transitional moment, a point where a certain experience fits into certain thoughts and takes them a step forward. Duckworth feels there is a powerful pedagogical point with two aspects that can be made from this. The first aspect is that the right question at the right time can move children to heights in their thinking and result in significant forward steps and intellectual excitement. The second, and very important aspect of this, is that although it may be almost impossible for a teacher to know what the right question is for an individual child, that child can raise the question for her/himself if the setting is right. The best teaching involves giving children the opportunity to have wonderful ideas and allow them to feel good about themselves for having them (Duckworth 1987, 5). Too many times children's ideas are looked at by adults as being trivial or unacceptable. They are not valued. If we take children and their ideas seriously, we can do much towards advancing their intellectual development. As educators we need to be willing to accept children's ideas and to provide settings that suggest wonderful ideas to children (Duckworth 1987, 7).

In doing science with children, I find them continually asking questions of me and each other. I feel it is my job to be aware of their questions, where they are in their thinking, and to allow them to find their own answers to their own questions. "What question the children find an answer to is not very important. What is important is that they realize that answers can be found through their own investigations" (Duckworth 1987, 59). Many times children's questions simply need to be handed back to them. Not telling the answers to questions is not just a teaching gimmick--it is essential. As science teachers we should be trying to develop the belief that "I can find out--," not the belief that the right answer is what is most important (Duckworth 1987, 60).

In traditional science education, "reinforcing the right answer" is what is of most importance. Throwing a monkey wrench or being the devil's advocate, instead of reinforcing the right answer may seem to be a contrary way of teaching. It is important to do this, though, for several reasons. One is that it is a way of finding out for sure if the students have an understanding of the phenomena. Another is that it is a way for the teacher to remain noncommittal so that the students can construct their own knowledge. A third is that it helps encourage critical thinking by not accepting the student's understanding too readily at an early stage. The last is that it helps to find any areas that require more thinking by the student (Duckworth 1987,133).

One of the problems in traditional science curricula is the belief that the "right" answer must be taught. Duckworth has a wonderful statement about this:

> It occurred to me, then, that of all the virtues related to intellectual functioning, the most passive is the virtue of knowing the right answer. Knowing the right answer requires no decisions, carries no risks, and makes no demands. It is automatic. It is thoughtless.
>
> Moreover, and most to the point in this context, knowing the right answer is overrated. It is a virtue--there is no debate about that--but in conventional views of intelligence it tends to be given far too much weight (Duckworth 1987, 64).

In traditional classrooms we tend to focus on the right answer quickly given. We not only want the right answer we want it given as quickly as possible. Timed tests are given to see which children can give the right answers more quickly than others. I know many children who have been devastated by these tests. These are bright children, good at and willing to put time into problem solving, who do not do well under the stress of pressured tests. These same children do not think of themselves as being very smart because of these testing methods. It seems to me to be a very petty way of judging children. It would be more valuable to focus on the value of being able and willing to spend time finding something out, rather than already knowing the right answer.

On the whole, teachers are too anxious to give information and answers. As I've read and discovered the rationale behind not giving answers, I find myself better able to be quiet and allow students to find their own answers. Students aren't always happy when I won't tell them if their answer is "right" and instead tell them there aren't always right answers or that whatever answer they get is the right one. Joe Elstgeest states ". . . we must begin to look for a new kind of 'right' answer. We must begin to look for a right answer which the

children can give with confidence, which depends on their own observations: a right answer which originates from their experiences" (Harlen 1985, 14). This is the first year I've really focused on this process and I'm already starting to see changes in student's attitudes. As a whole, they are becoming much less concerned with what the "right" answer is and more involved in the process, their own answers, and comparing their own answers with others in the group without feeling that anyone is "wrong" when their answers are different. I feel that, particularly in an experiential science program, this type of learning is much more valuable than learning the right answer. It is valuable in terms of the development of creative and critical thinking, as well as intellectual development.

There exists too much complexity and diversity in the material world for children to become familiar with during the elementary school years. It is, in fact, not possible to teach children about the physical and biological world merely in terms of facts. Duckworth feels that instead we need to make scientific knowledge seem interesting and accessible. I don't feel we really need to make scientific knowledge seem interesting. It is interesting, and different parts of science are interesting to different students. It is more important not to make something that is inherently interesting, seem uninteresting by turning it merely into facts to be memorized and given back in a test. To keep science interesting we do need to make this knowledge as accessible as possible. We can do this by allowing children to become familiar with a few phenomena "in such a way as to catch their interest, to let them raise and answer their own questions, to let them realize that their ideas are significant--so that

they have the interest, the ability, and the self-confidence to go on by themselves" (Duckworth 1987, 8). Duckworth considers this to be a curriculum program, but one with a difference. The difference is characterized by the unexpected being valued. This was done in the African Primary Science Program. Booklets were developed for this program, but it was not expected that children and teachers would do only what was specified in the booklets. Instead the intention was that there would be so many unanticipated ideas by the children and teachers that the booklets would not even be used. The teacher's guide's were merely a starting point to give the teacher ideas.

Another program that Duckworth helped develop, along these same lines, was the Elementary Science Study or ESS. ESS is the one U.S. science curriculum program most consistent with Piagetian psychology (Duckworth 1987, 34). ESS's Small Things teacher's guide encourages questioning and answering being done by the students. The introduction states:

> If the teacher makes the generalizations, the spirit of exploration will be lost. The process of discovering for oneself is something more valuable than the answers. What the pupil learns about measurement and evaluation of evidence and about intelligent use of his own senses and instruments will have longer 'mileage' in his scientific education than merely learning a 'cell' theory (Elementary Science Study 1967, 1).

The ESS program was based on the belief that children's science learning happens best through their own investigations, when properly encouraged and supported. The teacher's guides for this program evolved through repeated personal experience in work with

children (Duckworth & others, 113). What is interesting to me is that these are the teacher's guides that I have felt the most comfortable using since I discovered them in the late 1960's. I have most of them and still use them. Some of the ones I have used the most are Sink or Float, Growing Seeds, Gases and "Airs", Small Things, Mystery Powders, Batteries and Bulbs, and Clay Boats. It was exciting for me to read literature by the people who were involved in developing these guides. It was also extremely helpful to read the theory and rationale behind their use. After reading Piaget and Duckworth, I have a much better understanding of how these guides are to be used. Duckworth felt that the danger in even having a teacher's guide was that teachers would see the ideas in the guides as activities their students must do (Duckworth 1987, 8). Teachers are so used to following teacher's guides explicitly that the idea of taking the guide as simply a beginning and then following the interests and direction of the students would be a hard one for most teachers to do. I had a tendency to follow the guides more closely than they need to be followed, and to want students to focus on the activities in the guides. I tended to allow students to go their own way, but then I would want them to get back to the activities in the guide. Now I feel very comfortable about and have a better understanding about how to allow students to go their own way.

There is much discussion about "concepts" in science curricula. A concept is an idea generalized from a particular experience. Examples of concepts are metals, heat, expansion, plant, cell, and sound (Carin and Sund 1989, 12). In traditional education, objectives are built around the learning of concepts. According to Loucks-

Horsley the development of a new curriculum does not call for a common scope and sequence centered around a few themes or to develop units of study for identified themes or organizing concepts. Instead we need to look for ways to illustrate or reinforce a set of major concepts. They feel that scientific concepts such as diversity, variation, order, structure, function, model, scale, system, subsystem, and change integrate diverse topics; that concepts bring coherence to the natural world and unite scientific disciplines; and that they bring coherence to information and experience and enable lifelong learning (Loucks-Horsley and others 1990, 18). These authors feel that it is important to nurture conceptual development without focusing on the concepts themselves as units of study. They prefer instead a thematic approach which includes major scientific concepts. I.feel that they are on the right track, but that from a constructivist paradigm, concepts are not what bring coherence. The learner's own construction and integration of what s/he is learning is what brings coherence. I feel that the use of the words concepts and content have a similar use in science curricula and that it is better not to even talk of teaching concepts, as you then get away from teaching children and teaching through their interests.

Piaget felt that the development of major scientific concepts is the consequence of the development of mental operations. These operations are what children develop as they go through assimilation, accommodation, and equilibration. They are the process children go through as they learn. Piaget suggests that pupils are capable of developing an understanding of physical principles without instruction, and that, in fact, formal instruction obstructs

learning (Hodgson and Scanlon 1985,103). I would agree that traditional formal instruction obstructs learning, but I feel that teaching as a facilitator doesn't.

Duckworth feels that many of the things she wants children to learn cannot be summed up as a science "concept," which is a noun. She feels that instead of nouns we should use sentences that represent beliefs we wish children to develop. For example, more important than simply learning the use of the microscope and how it works is that they learn ". . .that all around them there is a world of tiny things they have never seen before, or even thought of trying to see; that it is fun to see these things; that they can make a tool to look at these things out of simple, unmysterious materials; that if they share with their friends the things they see, everybody is likely to end up seeing more. . ." (Duckworth 1987, 52). She also feels, and I agree, that teaching some beliefs may get in the way of teaching others. For instance, we may have to decide what is more important, learning the physics of how a microscope works or learning how much fun it is to use a microscope. This involves a total changing of priorities in how science is taught. ". . . a class in which every child takes his magnifier home with him at night and runs back for it if he forgets it, but nobody knows that the apparent size is a function of distance, would score 95 out of 100, whereas the inverse case (all know the rule but nobody looks unless they're told to) would score 5" (Duckworth 1987, 59). Again, as with content, I feel children will learn scientific concepts through process.

The idea of giving children choice and how much comes up again and again in the literature on science curriculum. Androula Henriques states:

> To make plans for attaining a goal that one has chosen according to one's own interests and cognitive capacity is an emotionally enriching experience very different from the frustration of following the written instructions of an exercise, especially because one does not often understand the logic behind the series of manipulations that, like magic, give the result predicted by the teacher (Duckworth and others 1990, 181).

Learning best occurs when there is a match between logical demands of the curriculum and cognitive capabilities of the child. The traditional way of dealing with this is to test the child and match the curriculum to the child. The experiential way of doing this would be to allow the children to make the choices in their own curriculum based on their own interests. The entire constructivist tradition is based on the idea of student self-determination--the opportunity for students to see learning as something "under their control rather than as disembodied, objectified, subject matter" (Kohn 1993, 13). One student stated that being able to make choices in his math curriculum and grades "leads to learning rather than just remembering" (Kohn 1993, 11). High school seniors in Minneapolis were given chemistry problems without specific instructions. They had to decide for themselves how to find solutions to the problems and "consistently produced better write-ups of experiments" and retained information better than students given exact instructions on what to do (Kohn 1993, 12). There are also reasons other than just academic to allow children choices about their learning. The best

predictor of burn-out is not too much work or too little time--it is powerlessness or a lack of control over what one is doing (Kohn 1993, 10).

In order to make major shifts in how we teach science and what our goals are, there also needs to be major shifts in teacher education. We need this shift in teacher education so that teachers, both old and new, can learn to teach in new ways. There are four major aspects of teacher education that need to be taken into account. First, teachers need to learn in the way that children in their classes will be learning. This means being involved in classes or workshops where teachers learn take their own knowledge seriously, where they are willing to pay attention to their own confusion, where they make the effort to understand each other's ways of understanding the phenomena, and they take the risk of offering ideas of which they are not sure (Duckworth 1987, 84). In this setting teacher's would actually learn first hand about constructing their own knowledge. Second, teachers need to work closely with one or two children so that they can observe them carefully. One way for teachers to learn about Piagetian theory is for them the learn to "be" Piaget when working with children. When working with children in this way, they learn: that the emphasis is on what children are thinking, not its rightness or wrongness; they put effort into finding a way to ask questions that does not tell their answers; they learn how to be silent, and that silence is productive. Third, it would be valuable for teachers to see films or live demonstrations of a class of children learning in this way. Finally, and very important, is that teachers need the support of co-workers

trying to make the same changes (Duckworth 1987, 10). It would be extremely difficult to work in a situation where co-workers do not understand and may even be antagonistic to what you are doing, and to not have feedback about what is being done. Teachers build on their knowledge by interacting with each other in the same way children do.

An important part of teacher education would be to help teachers make connections with children's ways of giving different meaning to the same experience (Duckworth 1987,105). We need to work at really understanding the child's reasoning when s/he is working with science materials. "As teachers, we need to respect the meaning our students are giving to the events that we share. In the interest of making connections between their understanding and ours, we must adopt an insider's view: seek to understand their sense as well as help them understand ours" (Duckworth 1987,112). Some of the teachers Duckworth has worked with called this to "give a child reason"--to try to understand the way in which what a child says or does could be construed to make sense when the meaning is not immediately obvious (Duckworth 1987, 86).

Teachers are in a position to pursue questions about the development of understanding that could not be pursued in any other way. If teachers are interested in how children build their understanding, then the way to gain insight is to watch them do it, to try to make sense of it as it happens, and to document what is observed. A teacher could be anyone whose goal is to engage learners wholly--to involve their mind, sense of self, sense of humor, range of interests, and interactions with other people, in learning

(Duckworth 1987, 134). Teaching, looked at in this way, could be an indispensable part of learning research. A researcher can be a teacher in the sense of caring about some part of the world and how it works enough to want to make it available to others; s/he would be fascinated by the questions of how to engage children in the world and how children make sense of it; would have time and resources to pursue these questions to the depth of her/his interest, to write about what was learned, and to contribute to the theoretical and pedagogical discussions on the nature and development of human learning. As traditional schools are set up now, classroom teachers do not have time to do all of this. But there is no reason not to "rearrange the resources available for education" so that the above description defines the job of a classroom teacher (Duckworth 1987, 140).

> . . . children have a way of letting us know what it is they understand and what they need. Blank looks, laughter, frustration, and excitement instruct us as well as theories of development and models of learning. Theory is based on research. We can, in effect, work as researchers in the classroom, observing children carefully, listening to what they say, noting when our responses seem to baffle them and when we help them take a step forward. Science textbooks may offer us information to present or questions to raise, but only our careful attention to children will enable us to gather information about what they find interesting or puzzling, which ideas they understand and which ones confuse them (Doris 1991, 11).

The research on this chapter gave me a wealth of information about how children learn experientially in a science setting and how this learning relates to children constructing their own knowledge. This research was especially helpful in showing me the importance of

activity-based learning in a science setting. Here I was able to relate what I learned in doing Piagetian tasks with children to the theory of experiential education in a science setting. Also, in doing this research, I found many theorists and educators who are using constructivism as the basis for their work with children in the area of science. This was very exciting for me. I now know there are people out there working for the same goals I am in the field of science education.

CHAPTER 7

EXPERIENTIAL EDUCATION AND CURRICULUM IMPROVEMENT

In this chapter I want to focus on the need for curriculum improvement in general to take into consideration experiential learning and constructivism. I want to discuss this more generally as constructivism applies to all content areas, not just science. Experiential education and constructivism are key to the concept of educating for understanding rather than learning using rote methods. The New Webster's Dictionary defines curriculum as a specified fixed course of study. By definition, curriculum does not "fit" with experiential education. Experiential education, based on Piagetian theory, cannot be a fixed course of study, as it is based on the interests of the individual child. What then would a curriculum based on experiential learning consist of? To start with, the word curriculum would have to be redefined to some extent. It would become a fixed course of study in retrospect, rather than a fixed course of study to begin with. A teacher could look back at a year's worth of work a child had completed and say, "This was the curriculum for this child for this year." This is basically what we do at Kino. It is what makes the most sense for experiential education and what works best for each individual child. I have found that education reformers have many similar ideas when considering making curriculum changes based on experiential learning. I will discuss these ideas, the background of the ideas, and what

curriculum changes can be made to better implement experiential learning.

I will start with the idea of process-oriented learning vs. product-oriented learning, as process-oriented learning is a very fundamental part of experiential learning. At the present, traditional schools focus on product rather than process. It is because of this that process is totally left out and little content is really learned. So little content is retained because it is memorized, usually for a test, rather than really learned. I believe that if we focus on process rather than product, children will learn how to think and at the same time will remember the content and therefore have really learned. They will remember it because it is learned in connection with the process and is internalized.

As stated in chapter 1, one of the earliest educators to advocate curriculum changes based on experiential education was William Heard Kilpatrick. It is always surprising to read about his ideas, which are very similar to what education reformers are saying today about curriculum change. Kilpatrick felt that there should be a shift in curriculum from the static outlook of content to the dynamic outlook of process (Kilpatrick 1936, 46). This is one of the central differences between traditional curriculum and experiential curriculum and comes up again and again in writings on curriculum change. Unfortunately, it seems to be extremely difficult for traditional teachers and administrators to give up the security of teaching content. Kilpatrick felt that the educative process involved the child: having an interest; "figuring out" the situation; making plans; putting the plans into action; and evaluating the work. This

process was usually done in the form of a project. He felt this process was self-directed and contained its own inherent testing. (Kilpatrick 1936, 51). Kilpatrick felt that there was not necessarily a greater amount learned, but that what was learned was more valuable because of the dynamic and meaningful connections made (Kilpatrick 1936, 109). In other words, it was truly learned; it was not just facts memorized and forgotten. Kilpatrick felt educational objectives should be: to think in terms of the growth of the child--rather than specific facts and skills, the child's present activities would lead to further and more advanced activities; to work for ideals rather than for lists--correct spelling should be taught as words are used, rather than lists to be memorized; to work to build dynamic interests starting with the child's present interests; and to work for self-direction--her/his satisfaction and motivation would come from the excitement of learning instead of external rewards (Kilpatrick 1936, 113).

Although Kilpatrick does not quote Piaget, or give any reference to him, I feel he may have known his writings. He states, "The pattern so accepted to act on henceforth becomes by and through the fact of acceptance incorporated into the person's very organism along with and among all the rest that makes up his character" (Kilpatrick 1936, 27). This is very much like Piaget's description of assimilation and accommodation. Kilpatrick describes the two phases of learning as creative and incorporative. The creative would be similar to the pure assimilation of play. The incorporative would be similar to the pure accommodation of imitation. He felt that new knowledge was incorporated into the old

and that the self was in a process of continual rebuilding. This is very much like Piaget's equilibration. Piaget's earliest works were published in the early 1920's, while Remaking the Curriculum by Kilpatrick was published in 1936. I feel it would be coincidental if these were entirely Kilpatrick's own ideas, and he had no knowledge of Piaget and his work.

Howard Gardner is a professor of education at the Harvard Graduate School of Education. He has written several books advocating new ways of looking at the way people learn. Most of his views are based on the theories of Jean Piaget and Jerome Bruner, as well as his own theories and conclusions. He looks at process vs. product as learning for understanding vs. rote learning. Gardner brings up the issue of how knowledge is to be taught. He feels there are two ways and that they are very much in contrast with each other. One is call "mimetic" education. In this type of education the student mimics or imitates the performances desired by the teacher. The teacher acts as the authority and source of all knowledge. Any deviation from the required performance is rejected. This is the basic skills approach. The contrasting way of teaching is called "transformative" education. In this way of teaching the teacher acts as a facilitator. The teacher has the job of encouraging the student to work out her/his own ideas, to test those ideas, and to develop her/his own understandings. This is the creative approach (Gardner 1991, 119). I feel that both Kilpatrick's objectives for education and Gardner's transformative education are similar and that both are an excellent basis for curriculum reform.

Gardner criticizes traditional schooling methods and feels we need to teach for genuine understanding. By this he simply means that students need to have truly internalized and know a concept rather than the rote learning and memorization that now passes for understanding. In order to teach for genuine understanding we need to teach children to think critically. Rather than teaching rote learning and memorization we need to teach children to look at issues and contradictions in their concepts and allow them to work out their own solutions. This fits in with Piaget's idea of allowing a child to construct their own knowledge in order to have that knowledge really internalized. The curriculum should be based on having a deep understanding of the concepts and principles underlying bodies of knowledge. Gardner feels that the student should arrive at these concepts and principles based on her/his own explorations and then ultimately reconcile those concepts and principles with those in the various disciplines (Gardner 1991, 117).

Along with Gardner's criticisms of traditional education he criticizes the "back to basics" movement. Gardner feels what is missing in the focus on the teaching of basic skills is the ability to read for understanding and the desire to read at all (Gardner 1991, 186). Teaching decoding is not difficult, but simply decoding words is not reading. There are many children that I know, who in a traditional system learned to decode, but have little or no comprehension of what they read, even when the whole purpose of reading is to get information. These same children hate to read and only do it when they have to. The same is true of writing and math. Children are simply taught these subjects in a rote manner with no

understanding of their practical everyday uses and no connection to their lives. Gardner tells the story of a teacher he met at a conference who argued that by teaching basic skills and just teaching facts, "teachers can cut short the discovery process and save students time" (Gardner 1991, 187). This teacher obviously did not understand that the way children learn is through the discovery process. Not only is she inhibiting the child's learning by not allowing discovery, she is also taking the joy of learning away from the child. She is not doing children any favors by "saving" them time.

As well as discussing the limits of focusing on basics skills, Gardner also discusses the limits of progressive education. He feels there are two main limitations. One is that progressive education was not sensitive to problems children might encounter in a school setting: problems acquiring basic skills, lack of motivation, and learning styles that make it difficult to master disciplines of school. The other limitation was the lack of assessment (Gardner 1991, 196). I don't really agree with him on either of these. I feel if the goals for progressive schools were the same as traditional schools then these limitations would be valid. For me the goals, and more importantly the philosophy, are entirely different. If learning and school are to be looked at in a whole new way, as Gardner suggests, then these limitations are not valid. School needs to be looked at as a community--as a place where children come to do those things they're interested in and learn in the process of doing them, and as a place where teachers and other students and adults facilitate each other's learning. What happens in progressive schools that does not

happen in traditional schools is that the individual child's needs are thought about and dealt with.

Assessment by traditional schools is done for the most part to appease someone else, not to help children. I believe assessment should not be done in any formal way. It should be ongoing and a part of learning. It also should not be done for the purpose of judging, but to help facilitate the child's further learning. It seems to me that one of the main purposes of testing, at this point in time, is to categorize or label students. Educators and psychologists want to label children so they can then provide a "formula" for "fixing" the child. This is a much easier way of dealing with children than looking at them as individuals. Bill Ayers discusses labeling and how damaging it is to label children; how labeling causes us to focus on what children can't do rather than what they can do. He states that the problem is ". . . in the human-centered act of teaching, all attempts to define categories lower our sight, misdirect our vision, and mislead our intentions" (Ayers 1993, 29). He feels, and I agree, that labels are limiting; that they focus on a single deficit when what is needed are many ways of seeing children's ever-changing strengths. He feels that labels conceal more than they reveal. I feel that labeling is one of the most damaging things we do to children. As soon as a child is labeled, what educators then see is the label instead of seeing the child. One of the reasons I do not believe in labeling is because I believe that each individual child is who s/he is and is where s/he is and should be allowed to be there without negative labels. It's been my experience that labeling children has nothing but detrimental consequences. They are being told that they

shouldn't be who they are or be where they are; that they are somehow lacking. Labeling does not in any way help a child to grow as a person either emotionally or intellectually. What we need to do is accept each child where they are right now and go from there. We need to look at their strengths and build on them, not focus on their weaknesses. We need to look at every child, whether they are "gifted," "normal," or "slow," as unique individuals who need our support and respect and encouragement to grow. This is what real individualized learning is about.

Gardner feels school, as an institution, is difficult for children because: materials presented in school are alien to students; some notational systems, concepts, frameworks, and epistemic forms are not readily mastered; and scholastic forms of knowing may collide with earlier forms of sensorimoter and symbolic knowing (Gardner 1991, 149). I feel school is difficult for many children because of the above, as well as several other reasons. School is a foreign environment and unlike anything children will encounter as adults. Gardner includes a quote by journalist Tracy Kidder:

> The problem is fundamental. Put twenty or more children of roughly the same age in a little room, confine them to desks, make them wait in lines, make them behave. It is as if a secret committee, now lost to history, had made a study of children and, having figured out what the greatest number were least disposed to do, declared that all of them should do it (Gardner 1991, 138).

It's as if we have deliberately set out to make school difficult for children--as if by making it difficult it somehow means children are really learning. I have heard students state that they don't think

they're learning if they're enjoying themselves. I think the most learning occurs when there is joy in learning.

Gardner describes seven intelligences that he feels all humans have to a greater or less degree. These intelligences are language, spatial, musical, logical/mathematical, body, knowledge of other individuals, and an understanding of ourselves. Most schools stress linguistic and logical intelligences (Gardner 1991, 81). This leaves out students who learn best using other intelligences and contributes to making school difficult for children. Gardner feels that an education built on multiple intelligences would be much more effective than one built on just two. I agree with this. This is part of individualizing education in order to meet the needs of all students. Gardner feels school isn't even working for those it seems to work for. A child who does well on tests and gets "good" grades is still not really being served if s/he cannot use the information "learned" in new situations. Knowledge, of course, is not really learned if it cannot be used in new situations. So the children the system is working best for, aren't really being served, and the children the system is working worst for, are being destroyed.

John Gatto was an award-winning teacher in the New York City Schools for twenty-six years. Some of his ideas seem to be based on Piagetian theory. He states that, "People have to be allowed to make their own mistakes and try again, or they will never master themselves, although they may well seem to be competent when they have in fact only memorized or imitated someone else's performance" (Gatto 1992, xiv). Jean Piaget, Jerome Bruner, and Howard Gardener all state basically this same idea: that

regurgitating facts in not real understanding. A curriculum based on real understanding involves allowing students to make mistakes and learn from their mistakes; it means allowing students to feel competent and in control of their own lives and learning so that they feel empowered; it means allowing students to construct their own knowledge.

Jerome Bruner's theory is closely related to Piaget's. His emphasis is also on the process of learning rather than the product. Bruner has developed curriculum based on the use of what he calls guided discovery. Guided discovery is the teaching of problem solving with minimum teacher direction. He believes that the best way for students to learn to make discoveries is to have the opportunities to discover. Students develop their minds by using them and in the process receive the intrinsic reward of feeling empowered by their learning. In this way they develop self-direction. The use of extrinsic rewards, such as grades, promotes performing or learning only for the sake of the external reward. Research shows that using extrinsic motivation is more efficient in terms of the amount of time spent in learning a task, but information learned by intrinsic motivation is remembered longer and actually learned (Carin and Sund 1989, 95). This goes back to Eleanor Duckworth's idea of learning with breadth and depth. Bruner believes in the use of provocative questioning with maximum opportunity for exploration and trial and error; in creating incongruities in the material to create disequilibrium; in taking into account the learner's existing body of knowledge; the learner's stage of intellectual development; and how the learner represents

knowledge. In other words, Bruner believes in active learning and taking the individual into account--in child-centered learning (Cohen, Horak, and Stanley 1989, 37). This is all in agreement with experiential teaching and learning.

There seems to be some confusion and misinterpretation among curriculum reformers about what is really constructivist learning by the student and what is guided discovery learning by the teacher. Clement London states, " . . . the teacher elects to guide them (the students) in constructing the process themselves" (London 1990, 93). There is the idea that there can be shortcuts in the constructivist process by the student, that the process can be made to happen faster if the teacher guides the discovery and "helps" the student to construct the desired knowledge. This has nothing to do with allowing a child to construct her/his own knowledge. To truly construct knowledge the interest, desire and work of doing has to come from the learner and happen in the learner's own mind, without any preconceived ideas by the teacher of what the outcome should be. Teachers need to be able to truly let go, trust that children will learn, and know that each child will learn in the way that is best for her/him.

Barry Kaufman and Richard Konicek believe that so-called Piagetian curriculum has been used in the schools for the purpose of speeding up the child's intellectual growth (Kaufman and Konicek 1974, 6). This is not really possible and may, in fact, be harmful to the intellectual growth of the child, according to Piagetian theory. In the mind of American curriculum specialists, trying to speed up the time in which children spend in each stage is looked at as being

somehow better. Studies have shown, though, that speeding up the stages and concern with what stage a child is currently in is not better. Focusing on what "stage" children are in is simply another way of labeling, usually to their detriment, that is so prevalent in the traditional school systems of today. Piaget looked at all children as unique individuals and never meant for them to labeled into stages, as if one stage were better than another.

Another idea discussed by curriculum reformers has to do with the student's intuitive knowledge and how this knowledge can help rather than hinder the learning process. Gardner discusses the concept of the "unschooled mind." He defines the unschooled mind as the initial, intuitive conceptions and stereotypes that young children learn, usually in the home (Gardner 1991, 5). Children acquire a great deal of knowledge before attending school. They have intuitive understandings about the worlds of physical objects, living organisms, and human beings. From these understandings they develop their own theories about how things work and interact. These theories, though sometimes erroneous and probably because they are erroneous, are unfortunately ignored in formal schooling (Gardner 1991, 85). I say unfortunately because the best place to start with a child's learning is with the child's own ideas, even if the ideas are "wrong." Gardner feels that educators have not taken seriously and appreciated the strength of these early conceptions. He also feels that because these intuitive theories are largely ignored by traditional schooling they reoccur and are used in spite of later formal learning. Students who seem to do well in formal situations will still fall back on early intuitive learning when faced with new

problems. In order to deal with this, intuitive learning needs to be dealt with and reconciled with formal learning. Students need to confront the discrepancies between their intuitive theories and formal theories that have been developed by disciplinary experts (Gardner 1991, 91). I believe this needs to be done based on the individual's own learning style and using experiential learning.

Gardner feels that the challenge to educators is to: introduce counterintuitive notions to students; to make sure new knowledge is synthesized with earlier ideas; and to ensure newer content replaces previously held erroneous conceptions (Gardner 1991, 149). By introducing counterintuitive ideas to students they can look at and compare their intuitive ideas with actual happenings. An example would be to give a child who thinks rocks always sink in water pieces of pumice, along with other items that sink and float, to explore with. This helps them to synthesize their earlier knowledge with the new knowledge and helps to ensure that newer content replaces previous erroneous conceptions. This is making use of intuitive knowledge, even if it is "wrong," to help the student obtain real understanding. In this way, rather than just teaching facts and jumping through hoops, students do genuinely understand concepts. They can then use these concepts in new situations. This goes along with what Bruner feels about intutive knowledge. He feels that at each stage the children have a characteristic way of viewing the world and explaining what they are viewing to themselves. He also feels that curriculum must be structured so that it takes into account the child's way of viewing things (Bruner 1960, 33). He feels, as does Gardner, that the teaching method must take into account the natural

thought processes of the child. By allowing concrete experiences, children discover discrepancies for themselves between their erroneous conceptions and actual happenings (Bruner 1960, 42).

There is an attempt by some curriculum programs to teach operations rather than allowing the child to interact with objects to construct their own knowledge (Kaufman and Konicek 1974, 6). Kaufman and Konicek feel that in teaching an operation what is really taught is a copy of reality rather than allowing the child to organize reality to her/his structures. It makes much more sense to the authors and to me to create an environment where "children can deal with their environment in their own terms and make up knowledge that makes sense to them at the level they are capable of at that particular time in their development" (Kaufman and Konicek 1974, 13). This fits right in with both Gardner's and Bruner's idea of allowing children to discover their own erroneous conceptions. The 1969 Science Curriculum Improvement Study sourcebook states that young children have learned many commonsense, naturalistic concepts that have to be "unlearned." The authors feel that what SCIS is saying is that the child must for a period of time accommodate "his thought to that of the teacher, as he imitates her classification" (Kaufman and Konicek 1974, 9). Again, this is not what constructing your own knowledge is about.

Kilpatrick felt that the present living of the child must come first in the presentation of subject matter--that the curriculum must be based on the child's interests. He felt that the traditional curriculum, which was and still is made up of subjects divided into lessons, stressed acquisition and drill and minimized creative

thinking. The traditional curriculum was much more concerned with the future use of skills learned than the present use of skills learned (Kilpatrick 1936, 32). Children cannot relate to this. They live in the here and now. They need to see a present use of skills being learned and their learning needs to connect to their present lives. Kilpatrick's curriculum started with life as the beginning point of the subject matter. He felt that a worthwhile educational experience happened anytime a child faced a challenging situation and took the responsibility to deal with it. The child would have to deal creatively with the situation and therefore learn from it (Kilpatrick 1936, 32). He felt the curriculum unit should involve the child in facing an actual situation, rather than a specific lesson of subject matter to be learned. The curriculum should involve all of the child's life. The job of the teacher was to give wholehearted guidance (Kilpatrick 1936, 47).

Kilpatrick felt that the learner creates appropriate ways of meeting new situations, seeks out the materials and ways to learn from all available sources, and makes and tries out various plans for learning. S/he learns what s/he accepts as meeting the situations for her/him. The learning process has a purpose and is creative (Kilpatrick 1936, 29). This is learning based on the interests of the child and is what I feel all curriculum should be based on.

Project oriented learning, based on the child's interests, is a common theme with educators advocating an experiential-based curriculum. Kilpatrick formally developed the idea of the project method to give children a vehicle for pursuing their interests. One of Gardner's solutions for changing the traditional curriculum is to set

up apprenticeship programs and programs similar to museum programs for children. He feels that students need to work with each other on projects in order to challenge their intuitive understandings. He also feels that it is very important that teachers model involvement in projects (Gardner 1991, 243). I very much agree with this--this is also why apprenticeship programs are important. Children need to see adults involved in and passionate about their interests. Gatto feels any new curriculum needs to include independent study, community service, adventures and experience, large doses of privacy and solitude, and apprenticeships (Gatto 1992, 37). In other words, children should be involved in living as they learn.

Experiential education is not just a philosophy of education, it is a philosophy of life. When we discuss curriculum changes what we are really discussing is what our goals for children and society are--what knowledge and performances we value. Curriculum development is, of course, based upon the educational philosophy and psychology of the developer. Much of what I am finding shows that though Piaget's ideas are widely known and may even be agreed with, they are not much used in traditional school. Now that we know about Piaget's theories and how children construct knowledge, what have we done with this knowledge? Not much. We need to look at how this knowledge can be used to effect real changes in curriculum.

One idea that Gardner discusses that I do not agree with is the idea of a national curriculum. I do not think a national curriculum would solve any problems, and would probably create many more.

With a national curriculum goes the idea that someone else, an expert, knows what is best for individual children across the country. We could have a national policy of allowing children to determine their own curriculum from their own interests. This, though, would be very difficult to implement. Also, even the idea of an expert giving permission, so to speak, to allow children that kind of freedom is too controlling. Someone who gives permission can also take that permission away again. Gardner criticizes the having of ". . . hundreds of different educational programs and approaches in practice at any given time" (Gardner 1991, 256). In a country as large and diverse as ours, many different programs and approaches are to be expected. The one constant needs to be a curriculum based on the developmental patterns of and respect for individual children.

Curriculum reform needs to start with changing who develops curriculum. The teacher who works with the children needs to develop the curriculum rather than an administrator who is removed from the school and the children. Also, if curriculum is to start with a child's interests, as I feel it must, then the only person who can develop the curriculum and facilitate the child's learning is the teacher. When it comes right down to it, the person who really needs to develop the curriculum is the child, with the teacher being used by the child as needed as a facilitator. At Kino, every child's curriculum, as a whole, is different than every other child's curriculum. We do not have a set curriculum for the school or for each age group. It is dependent totally on the child's interests and skills.

Piaget felt the conditions for reforming curriculum were: the use of the active method; the teacher moving from the role of the authority to the role of a mentor; and that the teacher must know her/his own field and understand the development of the child's mind (Piaget 1973, 15). I am in agreement with all of these conditions. I do believe, though, that particularly in the education of elementary children, an understanding of the development of the child's mind is more important than a knowledge of a particular subject matter. I feel that there are times when it is better to learn along with the students, rather than always knowing all of the answers.

Kaufman and Konicek state that what is really needed is to change our view of children and teachers "across the board" (Kaufman and Konicek 1974, 12). I think this is fundamental to changing the curriculum in order to really meet the needs of children. Barry Kaufman and Richard Konicek state that Piagetian theory has little application to contemporary American education. They do point out, however, that, ". . . if educational theorists could truly understand what Piaget is saying, it could cause a revolution in education" (Kaufman and Konicek 1974, 1). I very much agree with this. Kaufman and Konicek discuss the differences between how Piaget is interpreted in developing curriculum and how Piaget's theories should actually be used in developing curriculum. They feel that the constructionist point of view is in opposition to the traditional idea of what the nature of knowledge is. The traditional viewpoints look at knowledge as either already formed types of knowing that develop as the child matures or a blank slate to be

formed solely by the environment. Traditional curriculum theorists look at knowledge as being static--something that the child learns merely by imitation. If looked at in this way, then the adult, with more maturity and knowledge of course knows what is best for the child to learn. If knowledge is looked at as being constructed by the child, then it must come out of the child's interests and the child would have to be the source of the curriculum. I think many adults cannot give up the power inherent in being the source of knowledge for the child. The adult may have a great need to be in control of the situation. Also, the teacher may feel that if children construct their own knowledge and the curriculum is based on the interests of each child, then the teacher has no purpose. This is not true at all. Children will always need adults to help them with what they are interested in learning.

John Gatto feels in his twenty-six years of teaching in the public schools that, as well as teaching, he also used his classes so that he could learn a broader range of what human possibility is (Gatto 1992, xi). He noticed that children who were not "smart" kept showing in random moments ". . . insight, wisdom, justice, resourcefulness, courage, originality . . ." This is when he began to wonder if it was being in school that was causing children to be "dumb"--if school itself was "dumbing them down". Because of this idea he started allowing children to be in positions to be their own teachers and ". . . make themselves the major text of their own education." Gatto dropped the idea that he was the expert, whose job it was to fill children's heads with knowledge. He instead began to explore how he could remove the obstacles that kept the "inherent

genius" of children from manifesting itself. This, of course, is what experiential education is all about. Gatto, instead of just teaching children, really observed them, listened to what they had to say, and learned from his observations.

Another central idea to curriculum changes based on experiential learning is that of the importance of critical thinking. One of Kilpatrick's central ideas, like Gardner and Gatto, was that students must learn to study and to criticize what they are studying. He felt that learning, rather than being mere acquisition of knowledge should be creative (Kilpatrick 1936, 17). I believe critical thinking is an end goal of an experiential-based curriculum. If we teach children to think critically about subject matter, then they will also carry that critical thinking to other areas, such as social concerns. This is something the status quo would not be happy with and is, I think, the reason we do not teach in this way. Quoted in Gatto's book is the social philosopher Hannah Arendt, who wrote, "The aim of totalitarian education has never been to instill convictions but to destroy the capacity to form any" (Gatto 1992, iii). Gatto feels that the economy we now have would not survive a generation of children trained to think critically. He feels that his teaching was based on an invisible curriculum that involved an economy based on a caste system (Gatto 1992, xiv). Gardner makes one small statement that ties in with this. He states, "Whether we will choose to follow this route, to educate for understanding, is a political issue rather than a scientific or pedagogical one" (Gardner 1991, 248). This is all he says, but I think he understands that changing the curriculum and our way of teaching in traditional

schools has nothing to do with what works educationally. It has to do with what works politically. This is the only reason that makes sense to me as to why we do not use experiential education and educate for understanding. Experiential education starts with the child and lets the child know that what s/he thinks is important. If we truly allow children to know that what they think is important, we will lose a control over them that we may never get back.

I would like to end with an assessment of the limitations of a constructivist, process approach to learning. I was asked, "What happens when teachers who are themselves unimaginative or lacking in the love of learning apply this approach?" First of all these teachers shouldn't be teaching. No matter what approach they use it will fail even if the goal is to produce simply educated individuals in the traditional sense. An unimaginative teacher who does not have a love of learning will certainly not be successful teaching using any methods. In discussing curriculum Bill Ayers states that there is no "teacher proof" curriculum that will humanize and energize the classroom of a deadly dull teacher and that there is no sense trying to find one (Ayers 1993, 90). Ayers further feels it is virtually impossible to teach experientially, ". . . if you have never felt the power of this approach as a learner" (Ayers 1993, 3). I agree with this. I think having learned experientially, as an adult, is an important factor in the ability to teach in this way.

I believe that teachers using a process approach to education must have: a belief in the innate goodness of people, including children; a belief that it is in the nature of children to learn, that what they do is learn all of the time; and an understanding of how

children construct their own knowledge. A teacher must also believe in the following constructivist principles: that children learn quickly when they are personally interested and mentally active; that the long range goal of education must be autonomy; and that teachers must reduce their power and encourage children to exchange points of view honestly to foster the development of autonomy in children (Kamii 1982, 4). Using a process approach to learning is hard work. It takes time and patience. Kamii feels that change will takes place slowly because:

> . . . constructivist teaching is the hardest kind of teaching ever invented. It is much easier and less threatening to follow a teacher's manual, go through reading groups day after day, give and correct worksheets, and make routine lesson plans for the entire week. Constructivist education requires that the teacher understand how the child is thinking and feeling, and raise an occasional question or make a tactful suggestion. . . . The most difficult part of constructivist teaching is that it requires change, not only of a teacher's method of teaching, but also of his entire way of thinking about himself (Kamii 1982, 9).

A common theme I've noticed in the literature by professionals who believe in experiential, constructivist learning is the importance of relationships--the relationships between teachers and learners, and learners and learners, and the relationships between learners and the environment. Bill Ayers states:

> I no longer believe the old saying that you can learn something from anything. I now think, given the intense relationships and connections that exist everywhere, that you can learn anything from everything. The challenge is to take it deeper, to pursue it further, to search more carefully and more thoroughly. Knowledge of the world presents itself whole. Teachers need to find ways to follow where it leads (Ayers 1993, 86).

Teachers need to understand that children do learn all of the time and they can and do learn from everything in their environment. Children already have a relationship with the world and we, as teachers, should make use of that relationship to help children learn.

Learning is also built on the relationship that is established between the teacher and learner. Teaching is not just the imparting of information. Bill Ayers makes this very clear in his book To Teach. He feels that a sustained interest in and a deep knowledge of another person is an act of love and good preparation for teaching (Ayers 1993, 18). Relationships are what Duckworth is talking about when she discusses giving a child reason. It means really paying attention to children and what they think. It means making a connection between children's meanings and our own. She feels that working with children means being present as a whole person, with your own thoughts and feelings, and accepting children as whole people, with their own thoughts and feelings (Duckworth 1987, 121). She goes on to say that in this setting children recognize the powerful experience of being taken seriously.

Bruner speaks of stance marking in speech when discussing the importance of the teacher-learner relationship. Stance is the way in which a teachers communicates to students their excitement or lack thereof for learning. It is the difference between being merely a giver of information or a fellow traveler and learner with the student. Stance marking in the speech of a teacher can be boringly informative or can be an invitation to students for negotiating the world of wonder and possibility. This again implies to students that their ideas are taken seriously. The teacher becomes a human event

and not a transmission device (Bruner 1986, 126). The only limitation to the process approach to learning are the limitations of the teachers involved with the children in the classroom. We don't accept second-rate doctors and we shouldn't accept second-rate teachers.

CONCLUSION

In doing this paper I learned many things, some of which I already knew, but didn't know how to articulate. I now know how to communicate what I know and believe about children and learning. I feel that I answered my primary question, "How do children learn experientially?" more than adequately. I learned that there are other people out there, many other people, whom I previously didn't know about, who are working for humane, experiential, constructivist education for children. I learned about the history of alternative education which gives me a feeling of continuity about the movement, where it came from, and where it's going. I have never enjoyed the process of learning as much as I have in doing this paper. I have been able to crystalize and clarify my thoughts and beliefs about education and children's learning.

There are several ideas I have only touched on briefly that I would like to end with in terms of their importance in experiential education. One I would like to speak to is the importance of community in learning. Learning is a communal activity. True learning can only take place with the exchange of ideas. Also, as Bill Ayers points out, physical, emotional, social, and intellectual growth must not be separated. He feels that culture is the frame through which we make sense of the world (Ayers 1993, 62). Bruner states that most learning is a communal activity, that it is not just that children must construct their own knowledge, but that they must do

so in a community of others who share their sense of belonging to a culture. He feels that the language of education, if it is to be an invitation to reflection and culture creating, cannot be the language of fact and "objectivity" (Bruner 1986, 129).

A main focus of education needs to be to clarify the goals of education and how educational philosophy is dependent upon these goals. We have to talk about the goals we have for society and our children. If a teacher's goal is to teach facts and obedience then s/he of course will not be interested in experiential, constructivist learning. If what we want, as it seems some people do, are adults that do what they're told, do not ask questions, and are unable to think for themselves, then what we get is the kind of society we now have--one is which people are not able to think creatively and are also angry and frustrated. If the goal is critically thinking, creative humans who are not only well educated, but able to take their place in a true democracy then an experiential, constructivist environment is what we need for children and we need to make changes in our school system to reflect these goals. Constance Kamii discusses autonomy as being the aim of education as envisioned by Piaget. Autonomy and constructivism were the two ideas from Piaget's theory that he himself identified as being most important. Autonomy means being governed by oneself, as opposed to heteronomy which means being governed by someone else. Piaget felt that children construct moral values from within, through interactions with the environment, in the same way they construct intellectual knowledge (Kamii 1984, 412). Kamii feels that Piaget's theory does not simply imply a different way of teaching traditional

subjects. What it implies is a totally different kind of schooling than the conformist education now taught.

Bill Ayers states very clearly why our goals of education need to change:

> Education will unfit anyone to be a slave. That is because education is bold, adventurous, creative, vivid, illuminating--in other words, education is for self-activating explorers of life, for those who would challenge fate, for doers and activists, for citizens. Training is for slaves, for loyal subjects, for tractable employees, for willing consumers, for obedient soldiers. Education tears down walls; training is all barbed wire (Ayers 1993, 138).

At this point in time constructivism seems to be growing into a much needed movement that could revitalized alternative education by giving the scientific evidence needed to show why and how experiential education works best for children and humankind. The result will be not only better educated adults, but more humane adults and a caring world.

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